

3076-00172

FINAL  
RECORD OF DECISION  
FOR  
OPERABLE UNIT NO. 2  
CASTLE AIR FORCE BASE  
MERCED COUNTY, CALIFORNIA

NOVEMBER 1993

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# DECLARATION FOR THE RECORD OF DECISION

## SITE NAME AND LOCATION

Castle Air Force Base

Operable Unit No. 2

Merced County, California

## STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the remedial action selected for Castle AFB, Operable Unit No. 2 (OU-2), in Merced County, California. OU-2 is defined as the contaminated ground water under the area on Base referred to as Discharge Area No. 4 (DA-4) and the contiguous area off-Base where contamination from Castle AFB has migrated, in the vicinity of Wallace Road (Figure 1), including all ground water along the interim OU-1/OU-2 boundary in Figure 1, which is not remediated by interim OU-1. The OU-2 system will be designed to remediate degraded ground water that is not laterally covered by the interim OU-1 system.

This remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) (42 U.S.C. Section 9601 et seq., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP: 40 C.F.R. Part 300). The attached Administrative Record Index (Attachment A) identifies the documents upon which the decision is based.

## ASSESSMENT OF OU-2

If the actual or threatened releases of hazardous substances for OU-2 are not addressed by implementing the remedial response action selected in this ROD, OU-2 may present an imminent and substantial endangerment to public health, welfare and/or the environment. Although a ground water removal action is underway in the area of OU-2, it is not known to what extent contamination has been controlled.

## DESCRIPTION OF THE SELECTED REMEDY

EPA, the U. S. Air Force, and the State of California, have selected Alternative II as the remedy for Castle AFB, OU-2. The selected remedy consists of:

- 1) Design, construction and operation of a ground water extraction and treatment system to treat extracted ground water with a packed tower air stripping method and carbon treatment of air stripper off-gases to levels that meet effluent limits set forth in this ROD, and
- 2) Discharge by injection of treated ground water to the same aquifer from which it was extracted, and
- 3) Ground water monitoring to demonstrate that the extraction system is effectively capturing the VOC contaminant plume, attainment of the cleanup standards established for OU-2, and compliance with all ARARs.

Implementation of this remedy will prevent the spread of ground water contamination and reduce the principal risk of human exposure to contaminated ground water. The ground water extraction and treatment system will operate until the cleanup standards are achieved throughout the area defined as OU-2. The OU-2 extraction/treatment/disposal system will be designed to compliment the hydraulic influences of interim OU-1 and nearby wells. Additionally, the OU-2 remedial design shall remediate any ground water contamination at its southern boundary not covered by the interim OU-1 remedial system.

## STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate for the remedial action and is cost-effective. This remedy employs permanent solutions and alternative treatment technologies to the maximum extent

practicable, and satisfies the statutory preference for remedies that employ treatment to reduce toxicity, mobility, or volume as a primary element. A five-year review will be conducted to determine the degree of mitigation achieved through remediation and the amount of contamination remaining in the ground water.

John W. Marc  
Felicia Marcus *for*  
Regional Administrator  
U.S. EPA, Region 9

11.12.93  
Date

Alan P. Babbitt Date  
~~Deputy for Hazardous Materials and Waste~~  
~~Deputy Assistant Secretary of the Air Force~~  
~~(Environment, Safety and Occupational Health)~~

James F. Boatright  
~~Deputy Assistant Secretary of the Air Force~~  
~~(Installations)~~

Nal Siebal  
Regional Administrator  
California/EPA  
Department of Toxic Substances Control  
Region I

Date

Anthony J. Landis  
Anthony J. Landis

11-30-93  
Date

DSMOA Technical Program Manager

California EPA

Department of Toxic Substances Control

Region 1

## DECISION SUMMARY

This decision summary provides an overview of the environmental concerns posed by OU-2. It also includes a description of the remedial alternatives considered in the Castle AFB RI/FS for OU-2 (January 1992) and the analysis of these alternatives when compared to criteria set forth in the National Contingency Plan (NCP). This Decision Summary explains the rationale for the selection of Alternative II and how the selected remedy satisfies the statutory requirements of CERCLA.

### I. SITE NAME, LOCATION AND DESCRIPTION

#### A. Site Name and Location

Castle Air Force Base  
Operable Unit No. 2  
Merced County, California

#### B. OU-2 Description

Operable Unit No. 2 (OU-2), is located both on Castle AFB and in an unincorporated portion of Merced County outside the city of Atwater, California. Ground water contamination underlies an area that is on-Base and known as Discharge Area No. 4 (DÁ-4) and a contiguous area off-Base (Wallace Road). The westward migration of volatile organic compounds (VOCs) in the ground water has proceeded beneath Wallace Road and has been detected near the intersection of Wallace Road and Santa Fe Drive (Figure 1).

Seventeen volatile organic compounds (Tables 1 and 2) have been detected in the ground water in the area of OU-2. Of these 17 detected VOCs, ten were determined to be present at levels that pose health risks. Following Region 9 Risk Assessment Guidance, chemicals that were detected in fewer than 5 percent of the analyzed samples were eliminated from consideration in the quantitative risk assessment. The ten remaining chemicals to be considered in the risk assessment are listed in Section VI.

Trichloroethylene (TCE) is the most prevalent and mobile contaminant, and is therefore determined to be an indicator chemical. The risk assessment contained in the RI/FS for OU-2 identifies TCE as the major contributor to health risks. The VOC chemicals which will be remedied in OU-2 are trichloroethylene (TCE), tetrachloroethylene (PCE), and benzene. While some lower health risk will remain due to remaining residual contamination from the VOCs, reducing the level of contamination of TCE, PCE and benzene to Maximum

Contaminant Levels (MCLs) will lower risks to an acceptable range of  $1.0E^{-4}$  to  $1.0E^{-6}$ . The concentrations of all VOCs will similarly be reduced by the remedial action.

OU-2 is the second ground water operable unit at Castle AFB. The contamination in OU-2 is a combination of ground water degradation associated with sources in the main base sector and DA-4. OU-1 and OU-2 are areas designated by the parties. Once ground water contamination moves into an area, ground water remediation will be performed under that operable unit. The ROD for interim OU-1 was finalized in August 1991 and the remedial system for interim OU-1 is currently under construction. Ultimately, the Comprehensive Base-wide RI/FS ROD will address any soils contamination and augment, as necessary, the ground water remedies associated with operable unit Nos. 1 and 2.

#### C. Land and Water Use

Land use within a two-mile radius of OU-2 is primarily agricultural. Crops grown in the area consist mostly of almonds, peaches, and grapes. Several small dairies and a large chicken farm are located to the east. Open pasture lands are located to the north and east. Residential areas are located primarily west of OU-2 and include Base housing, trailer parks, recently-constructed residential suburban housing and rural farm residences. Land use along Wallace Road is mixed residential and agricultural (i.e., orchards). Land use on the Base includes a mixture of industrial and light-industrial facilities, as well as military offices and housing.

According to the RI/FS for OU-2 (January 1992), approximately nine wells used for domestic and for agricultural purposes have been impacted by the VOC ground water contamination. An additional six wells in the immediate vicinity could be impacted by OU-2 VOC contamination if remedial action were not taken. This information was confirmed during the field activities completed in accordance with the "OU-2 Conceptual Design Support Technical Memorandum" (October 1993), and the data collected from routine sampling of domestic wells in the OU-2 area..

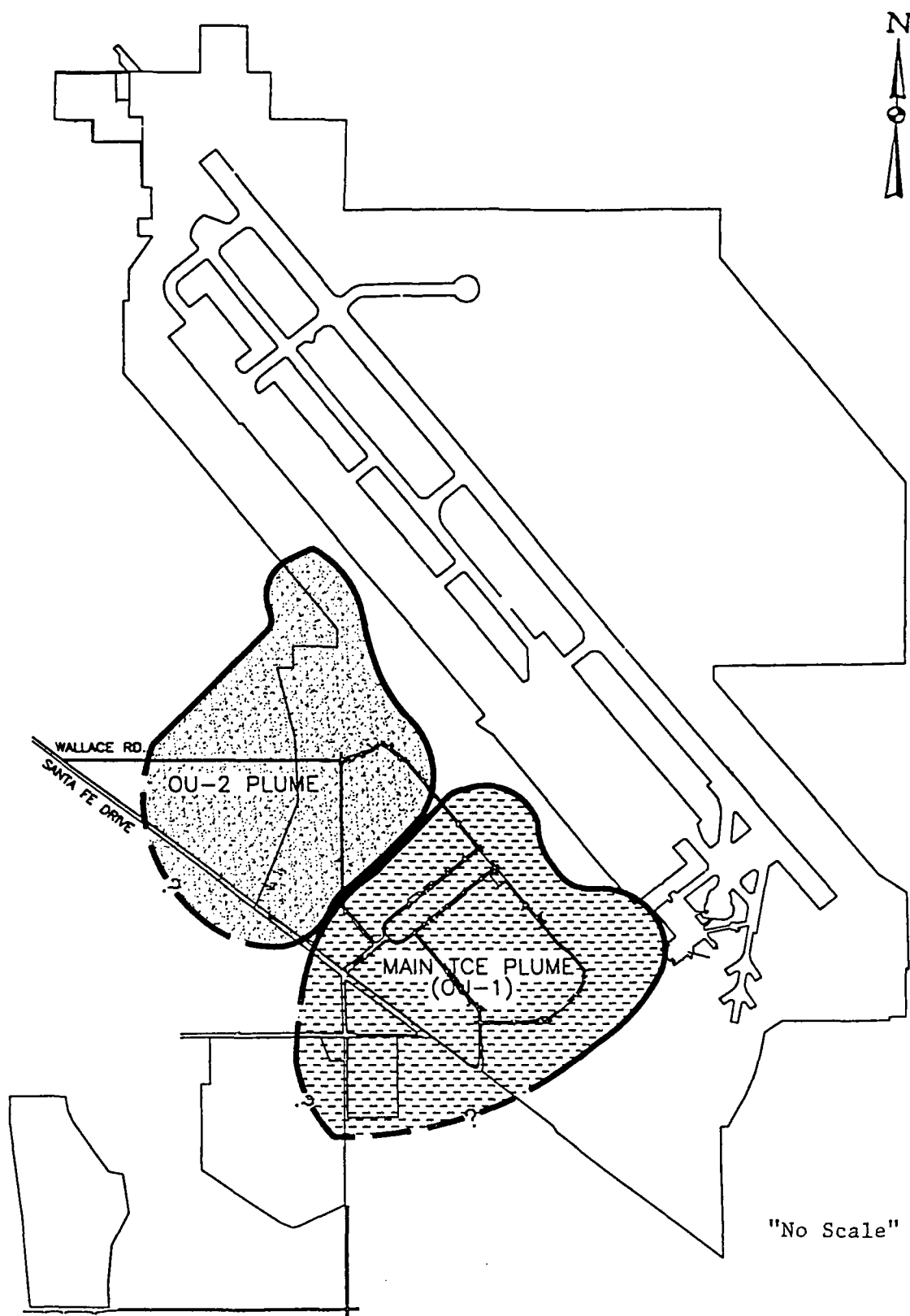
As part of a nation-wide military cut-back, Castle AFB is currently scheduled to close in September 1995.

#### D. Regional Topography

The Base is located in Merced County, California in the east central part of the San Joaquin Valley. Neighboring communities include Atwater, located to the immediate west, Winton, and Merced, located approximately 5 miles south of the Base.

The San Joaquin Valley forms the southern half of the Great Valley Geomorphic Province of California. This province is approximately 400 miles long and averages about 40 miles in width. It is bounded by the Sierra Nevada range to the east, the Coastal Range to the west, and is drained by the San Joaquin River. This river





—?— Approximate TCE plume boundary based on  
TCE MCL (5.0 ppb)  
(Queried where uncertain)



OU-2 Plume



Main TCE Plume (OU-1)

Operable Unit 2  
Castle Air Force Base

Figure

OU-2 Location Map

1

flows from the southeast to the Sacramento-San Joaquin Delta region, which lies between the Central Valley and the San Francisco Bay.

The Base is located about halfway between the Merced River and Black Rascal Creek, two southwest-flowing tributaries of the San Joaquin River. The valley floor in the vicinity of the Base area slopes gently to the west-southwest. Natural drainage is to the southwest; however, surface flow patterns are locally controlled by a system of drainage and irrigation canals.

The total relief across the Base is approximately 35 feet, ranging from 200 feet above mean sea level (MSL) at the northwestern corner to 165 feet MSL at the southern corner. Relief within the Base boundaries is essentially flat.

#### E. Geology/Hydrology

##### Geology

The eastern San Joaquin Valley of Central California is underlain by a basement complex composed of metamorphic and granitic rocks. In the vicinity of Castle AFB, the basement is overlain by a thick sequence of sedimentary deposits of Tertiary/Quaternary age (Figure 2).

Consolidated sedimentary units overlie the basement complex and have a minimum combined thickness of over 700 feet. These consolidated units include, from oldest to youngest, the Ione, Valley Springs and Mehrten Formations.

Unconsolidated sediments overlie these formations from an elevation of approximately 450 feet below MSL to an elevation of 165 feet above MSL. Beneath Castle AFB, the unconsolidated units include the Laguna, Turlock Lake, Riverbank, and Modesto Formations. Recent surficial dune deposits, which attain a maximum thickness of approximately 10 feet, occur at the ground surface.

##### Nature and Occurrence of Groundwater

The coarser-grained unconsolidated sediments (i.e., sands and gravels) underlying Castle AFB contain water that is tapped for water-supply purposes. Three water-bearing units have been identified in the unconsolidated sediments underlying Castle AFB, as shown in Figure 2. These units have been informally designated as the shallow, confined and deep aquifers, respectively.

An aquitard separates the shallow aquifer from the confining aquifer. The aquitard is primarily composed of fine-grained sediments (i.e., silts and clays) that are interbedded with water-bearing sands and gravels. Because these interbedded coarse-grained materials provide a source of water supply, the aquitard is also known as the "subshallow aquifer."

### Shallow Aquifer

The saturated portion of the Riverbank and Modesto Formations comprise the shallow aquifer, a hydrogeologic unit which has been locally developed for irrigation and domestic uses. The shallow aquifer is unconfined, and extends from the water table (at a depth of approximately 60 feet below the ground surface) to a depth of approximately 100 feet.

Interbedded sands, gravels and silts with minor clay are characteristic of the shallow aquifer, with the exception of the lower 10-to-20 feet, which is primarily composed of gravel. The portion of the shallow aquifer above the basal gravel is known as the "upper" shallow aquifer, while the basal gravel is referred to as the "lower" shallow aquifer.

Overdraft of wells completed in the shallow aquifer has resulted in a gradual decline in water table levels in the vicinity of Castle AFB. When Merced Irrigation District (MID) Well No. 8, located off-base approximately 2 miles south of DA-4, was installed in the 1920's, the water table was encountered less than 10 feet below the ground surface. The current depth of the water table, as measured in the well, is approximately 50 feet. The saturated thickness of the shallow aquifer has thus decreased about 40 feet in the last 70 years.

### Aquitard ("Subshallow Aquifer")

A marked change in grain size occurs beneath the basal gravel of the shallow aquifer at a depth of approximately 100 feet below the ground surface. Predominantly fine-grained sediments (i.e., silts and clays) beneath the gravel mark the top of the Turlock Lake Formation. The upper Turlock Lake Formation comprises the aquitard between the shallow and confined aquifers. The aquitard is approximately 165 feet thick, extending from a depth of about 100 feet to 265 feet below the ground surface.

Sand and gravel lenses occur in the aquitard that contain water. Wells completed in these lenticular zones supply water for both domestic and municipal use, as well as for irrigation. Due to the presence of these lenticular water-bearing zones, the aquitard is also known as the "subshallow aquifer." The aquitard also serves as the confining unit for the underlying confined aquifer.

### Confined Aquifer

In the vicinity of Castle AFB, the confined aquifer is comprised of the coarser-grained lower Turlock Lake Formation. The confined aquifer extends from a depth of approximately 265 feet to 350 feet (Weston, 1988) and is the most extensively developed aquifer in the area. The confined aquifer supplies water to the facilities on Castle AFB as well as to off-Base housing units. It also supplies water for irrigation purposes.

**Figure 2**  
**SUBSURFACE GEOLOGIC AND HYDROGEOLOGIC UNITS**  
**CASTLE AIR FORCE BASE OU-2**

APPROX. THICKNESS FT.	GEOLOGIC AGE	GEOLOGIC UNIT		HYDROGEOLOGIC UNIT			
0 - 10	Recent	Dune Sands		Vadose "Unsaturated" Zone  water table			
90-120	Quaternary	Modesto and Riverbank Formations				Shallow Aquifer	upper
							lower
200-300				Turlock Lake Formation	upper	Aquitard/ "Subshallow Aquifer"	
		lower	Confined Aquifer  - -? - -? - ?- -?- -				
200-250		Laguna Formation					
>700		Tertiary			Mehrten Formation		
0-400	Valley Springs Formation						
0-200	Ione Formation						
~	Pre- Tertiary	Basement Complex		Deep Aquifer			

(not to scale)

Wells completed in the confined aquifer yield an average of approximately 1,900 gallons per minute (gpm) and range upward to 4,450 gpm. Based on aquifer test data for Base Production Well No. PW-2, the transmissivity of the confined aquifer was calculated to be 51,000 gallons per day per foot [(gpd/ft), Castle AFB, Preliminary Site Characterization Report, June 1990]. Storativity was calculated to be approximately 0.0001.

#### Deep Aquifer

The deep aquifer occurs in the upper part of the Mehrten Formation. The top of the deep aquifer is approximately 650 feet below the ground surface. The actual vertical extent of the deep aquifer is unknown. However, the groundwater is known to become too saline below a depth of 1,200 feet to be used for a potable water supply or for irrigation purposes.

As discussed in the description of the subsurface geology for Castle AFB and vicinity, the Mehrten Formation consists of consolidated sedimentary deposits including claystone, siltstone, sandstone, and conglomerate. The deep aquifer supplies most of the water used at the Base and its off-Base housing units. Well yields range from about 1,320 to 2,100 gpm.

#### Groundwater Movement

The regional direction of groundwater flow in the eastern San Joaquin Valley is to the west-southwest. The primary source of natural recharge to the aquifers underlying the eastern San Joaquin Valley is storm runoff that infiltrates the Mehrten Formation and younger unconsolidated sediments which crop out to the east. Recharge from direct precipitation on the valley floor is limited by a very high evapotranspiration rate. Infiltration of precipitation on the valley floor is also inhibited by the presence of hardpan layers (caliche) in many of the valley soil profiles.

A secondary source of recharge in the region is percolation from irrigation. In the eastern San Joaquin Valley, sources of irrigation water are primarily surface water reservoirs formed by damming streams in the Sierra Nevada foothills during the growing season. Water from these sources is conveyed to the valley floor through natural and manmade channels.

Under natural conditions, groundwater flows to the San Joaquin River and its major tributaries, discharging as seepage to surface streams and marshes. Pumping of municipal, irrigation and Base production wells are major groundwater discharge zones that locally may exert considerable influence on the direction of groundwater flow. The vertical component of groundwater flow is downwards and is influenced by pumping groundwater from the deeper aquifers.

## II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

### Wallace Road Area

In 1978, following the sampling of several on-Base production wells, the Air Force identified TCE contamination in the ground water beneath the Base. In 1980, the Air Force and the Merced County Health Department began a well sampling program to assess potential impacts of contaminants on aquifers serving the local area wells. Figure 3 shows the locations of private and Air Force wells. One of the two areas where off-Base wells were found to be affected by TCE contamination is the Wallace Road Area, between Santa Fe Drive and the western boundary of the Base. Table 1 presents both a summary of the range of concentrations of the VOCs detected in ground water samples collected from wells in the Wallace Road area and their corresponding Federal and State Maximum Contaminant Levels (MCL's).

Table 1. SUMMARY OF VOC CONTAMINATION IN GROUND WATER IN WALLACE ROAD AREA µg/l			
COMPOUND	CONCENTRATION	FED-MCL	STATE-MCL
Trichloroethylene (TCE)	ND to 310	5	5
Benzene	ND to 12	5	1
Xylenes	ND to 4.4	1000	1750
Toluene	ND to 3.8	1000	---
Ethylbenzene	ND to 1.3	700	680
Dibromochloropropane (DBCP)	ND to 0.09	0.2	0.2
Chloromethane	ND to 5.8	---	---
Chlorobenzene	ND to 1.1	100	30
1,2-Dichlorobenzene	ND to 0.7	600	---
Methylene chloride	ND to 4.4	5	---
1,2-Dichloropropane	ND to 0.6	5	5
Note: ND = not detected. --- = no MCL.			

The Air Force initiated a ground water removal action in the area of OU-2 in 1991. The performance record of this removal action (e.g., total TCE removed, water treated, levels of TCE in surrounding monitoring wells and capture zone analysis) will be included in the design of OU-2.

#### Discharge Area No. 4

A summary of the range of each VOC parameter detected in ground water samples collected from wells at DA-4 is presented in Table 2, also presented are the corresponding Federal and State MCL's (i.e. for informational purposes).

DA-4 encompasses the liquid oxygen (LOX) facility (Buildings 1314 and 1316). The 12.5-ton LOX plant generated liquid oxygen until it was discontinued in 1959-1960. Building 1314 served as a toolshed and Building 1316 contained the liquid oxygen tanks. Currently, Building 1314 contains the office that handles liquid oxygen procurement from an outside contractor.

The process of producing liquid oxygen from air at the LOX plant required all parts that were touched or taken apart to be thoroughly cleaned with TCE. If parts were not properly cleaned, pressurized vessels had the potential to explode. To perform such extensive cleaning, former Base personnel stated TCE was poured into 55-gallon drums each month so that parts could be bathed in large quantities of the solvent. Spent TCE was thereafter disposed of into a concrete sump adjacent to the LOX plant. A concrete sump with drainage holes at the bottom is located on the northwest side of the slab that once served as the foundation of the LOX plant.

Investigative efforts have revealed that acid (less than 1%) was used to clean the drains at the LOX plant. The acid dumped into the drains caused the terra cotta pipes to become brittle. During replacement of the pipeline from Building 1309 to Building 1200, soils in the area of the LOX plant had the same citrus smell as the acid and caused a mild irritation to skin. It is possible that this pipeline provided an additional mechanism for TCE to be released.

Table 2. SUMMARY OF VOC CONTAMINATION IN GROUND WATER IN DA-4 AREA µg/l			
COMPOUND	CONCENTRATION	FED-MCL	STATE-MCL
Trichloroethylene (TCE)	ND to 5,600	5	5
Chloroform	ND to 12	100	---
Chloromethane	ND to 0.5	---	---
Freon 112	ND to 0.7	---	---
Tetrachloroethylene (PCE)	ND to 8.3	5	5
1,1,2-trichloroethane (TCA)	ND to 1.2	5	---
cis-1,2-dichloroethylene	ND to 2.3	70	6
Bromodichloromethane	ND to 0.5	100	---
Xylenes	ND to 4.4	1000	1750
Benzene	ND to 65	5	1
Toluene	ND to 2.6	1000	---
Ethylbenzene	ND to 0.9	700	680
Note: ND = not detected. --- = no MCL.			

### Enforcement History

Castle AFB was proposed for the National Priority List (NPL) of hazardous waste sites on July 22, 1987. The Base was officially listed as an NPL site on November 21, 1989. The U.S. EPA, the State of California, and the U.S. Air Force signed an interagency agreement, now known as the Castle AFB Federal Facility Agreement (FFA), on July 21, 1989. The FFA is a legal document that outlines the basic CERCLA process required of the Air Force, including CERCLA procedures to address state requirements, and documents the regulatory agency enforcement authority.

### III. HIGHLIGHTS OF COMMUNITY INVOLVEMENT

The Community Relations Plan (CRP) for Castle AFB was completed in 1990 and unofficially updated in January 1992 by Castle AFB's Office of Public Affairs, in accordance with EPA guidance. Consistent with the Base's Community Relations Plan, the Air Force established a Technical Review Committee composed of EPA, the State of California, the Air Force, Merced County, and local representatives from adjacent communities. The Technical Review Committee meets on a quarterly basis to provide the community



representatives with up-to-date information on recent milestone events. Castle AFB publishes and distributes "Environmental Update", a community newsletter, which also serves to keep the community informed of recent activities.

A public meeting occurred on May 18, 1992 on the OU-2 analysis of alternatives and the preferred remedy. A public comment period for the Proposed Plan for OU-2 was held between May 4, 1992 and June 3, 1992. A response to comments (Appendix B) is attached to this ROD.

#### IV. SCOPE AND ROLE OF THE OPERABLE UNIT

The identification of Discharge Area No. 4 and Wallace Road contamination as a ground water operable unit (OU-2) occurred in Spring of 1991. It was recognized by the EPA, the State of California and the Air Force that defining OU-2 as a ground-water-only operable unit (i.e., excluding soils) would allow for earlier initiation of ground water remedial action. The definition of OU-2 includes all aquifers which may be contaminated below the DA-4/Wallace Road areas and ground water contamination that may have migrated from these areas. The definition of OU-2 also includes any ground water contamination south of Wallace Road which is not addressed by interim OU-1. It was also recognized that further characterization of potential soil contamination would proceed under a subsequent investigation. Injection for the OU-2 remedial system will be designed to prevent exasperating the contaminant plume. This will be addressed during the RD/RA phase.

In 1986, when VOC contamination was identified in domestic wells Castle AFB began actions to protect public health by providing residents in the Wallace Road area with either carbon filtration units or a clean alternative water supply. Domestic wells in the vicinity are monitored regularly for contamination and, when necessary, the Air Force has provided additional residences with carbon filtration or alternative water supplies. The Air Force initiated ground water removal action near the area of Discharge Area No. 4 (on-Base) in July 1991 and additional pumping has commenced in the area of Wallace Road (on-Base) in December 1991.

Based on the information in the RI/FS for OU-2, finalized in January 1992, contaminant concentrations in the ground water exceed the Federal and California standards for drinking water for three compounds (Tables 1 and 2) and may present an imminent and substantial endangerment to human health. MCLs are exceeded for TCE, tetrachloroethylene, and benzene. Therefore, remediation of the ground water is required to reduce contaminant concentrations in the ground water.

The ROD for interim Operable Unit No. 1 (OU-1), also a ground-water-only operable unit, was finalized in August 1991. The objective of OU-1, is to initiate early action to clean-up the most heavily contaminated portion of the ground water under the main part of the Base and to attempt containment of the contamination in the Main Base Area. The remedial design for interim OU-1 was finalized in late 1992. Construction of the remedial system for interim OU-1 is expected to be complete in December 1993. Interim

OU-1 is adjacent to OU-2 (Figure 1) and there is no distinct division between the two areas of contaminated ground water. However, it is the intent of the Air Force, EPA, and Cal-EPA, to design the remedial systems of both interim OU-1 and OU-2 to be complementary.

In addition, the Air Force, EPA and Cal-EPA have planned the Comprehensive Base-wide RI/FS and ROD. This final RI/FS and ROD will re-evaluate all previous operable units as well as address any remaining contamination in the ground water and in soils. The final Comprehensive Base-wide RI/FS and ROD will also re-evaluate risks associated with overall Base contamination and provide an opportunity to re-examine the target clean-up levels established to protect human health and the environment.

## V. SUMMARY OF OU-2 INVESTIGATIONS

Several studies and investigations have been performed at the Base to identify the historical use of chemicals, the disposal of these chemicals into the soil and to determine the extent and impact of these chemicals on the ground water in and around the Base. The focus of this Record of Decision is on the findings of the investigations applicable to the Wallace Road Area and DA-4 areas (OU-2).

The pace of environmental investigative activities at Castle AFB increased in 1989. The investigation activities have consisted of sampling programs to : (1) characterize known on-site areas where hazardous substances were disposed of in the past, (2) characterize off-Base areas where contamination is known to have spread and (3) screen for the presence of contamination in areas where contamination may have spread.

Screening activities in the area of OU-2 included the testing of local orchard produce to determine if contamination-uptake was present in the local almond crop. Air sampling was performed during crop irrigation to determine if air-borne contamination could pose a potential health threat to local residents. Contamination was not detected during either the crop study or the ambient air sampling study.

A Base-wide VOC-probe investigative effort was conducted in 1991 to further delineate the vertical and horizontal extent of ground water contamination.

### A. Surface and Subsurface Soils

As a ground-water-only operable unit, soils will not be remediated under the ROD for OU-2. Additional vadose zone soils investigation for the on-Base area of OU-2 is planned in conjunction with the investigative effort for the Source Control Operable Unit and ROD.

Table 3. VOC, TPH, AND METALS ANALYTICAL PROTOCOL GROUND WATER SAMPLING ROUNDS 1 THROUGH 6						
Sampling point	Sampling round	VOC <sup>a</sup>		TPH <sup>b</sup>	CLP metals	Water quality parameters <sup>c</sup>
		EPA 601	EPA 602	EPA 8015		
MW440	1/2	X	X	X	X	X
	3/4/5	X	X	X	-- <sup>d</sup>	--
	6	--	--	--	--	--
MW455	1/2	X	X	X	X	X
	3/4/5	X	X	X	--	--
	6	--	-	--	--	--
MW501	1/2	X	X	X	X	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW502	1/2	X	X	X	X	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW503	1/2	X	X	X	X	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW504	1/2	X	X	X	X	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW505	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW506	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW507	1/2 <sup>e</sup>	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW508	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	X	X	--	--	--
MW509	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW510	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	X	X	--	--	--
MW511	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW512	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	X	X	--	--	--
MW513	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--

Table 3. VOC, TPH, AND METALS ANALYTICAL PROTOCOL  
GROUND WATER SAMPLING ROUNDS 1 THROUGH 6

Sampling point	Sampling round	VOC <sup>a</sup>		TPH <sup>b</sup>	CLP metals	Water quality parameters <sup>c</sup>
		EPA 601	EPA 602	EPA 8015		
MW514	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW515	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW516	1/2	X	X	X	--	X
	3/4/5	X	X	X	--	--
	6	--	--	--	--	--
MW576A	1/2/3/4	--	--	--	--	--
	5/6	X	X	--	--	--
MW601	1/2	X	X	--	--	X
	3/4/5	X	X	--	--	--
	6	--	--	--	--	--
MW602	1/2	X	X	--	--	X
	3/4/5	X	X	--	--	--
	6	--	--	--	--	--
MW604	1/2	X	X	--	--	X
	3/4/5	X	X	--	--	--
	6	--	--	--	--	--
MW701	1/2	X	X	--	--	X
	3/4/5	X	X	--	--	--
	6	--	--	--	--	--
MW702	1/2	X	X	--	--	X
	3/4/5	X	X	--	--	--
	6	--	--	--	--	--
MW702A	1/2/3	--	--	--	--	--
	4/5/6	X	X	--	--	--
MW703	1/2 <sup>d</sup>	X	X	--	--	X
	3/4/5	X	X	--	--	--
	6	--	--	--	--	--
MW704	1/2	X	X	--	--	X
	3/4/5/6	X	X	--	--	--
D5144	1/2	X	X	--	--	X
	3/4/5/6	--	--	--	--	--
D5266	1/2	X	X	--	--	X
	3/4/5/6	--	--	--	--	--
I5266	1/2	X	X	--	--	X
	3/4/5/6	--	--	--	--	--
D5486	1/2	X	X	--	--	X
	3/4/5/6	--	--	--	--	--
D5502	1/2	X	X	--	--	X
	3/4/5/6	--	--	--	--	--

Table 3. VOC, TPH, AND METALS ANALYTICAL PROTOCOL GROUND WATER SAMPLING ROUNDS 1 THROUGH 6						
Sampling point	Sampling round	VOC <sup>a</sup>		TPH <sup>b</sup>	CLP metals	Water quality parameters <sup>c</sup>
		EPA 601	EPA 602	EPA 8015		
15502	1/2	X	X	--	--	X
	3/4/5/6	--	--	--	--	--
MID70	1/2	X	X	--	--	X
	3/4/5/6	--	--	--	--	--
a. Volatile organic compounds. b. Total petroleum hydrocarbons. c. Total dissolved solids (EPA 160.1), major ions (EPA 300.0), hardness (EPA 130.2), pH (EPA 150.1), and specific conductance (EPA 120.1). d. Not analyzed. e. One of 17 wells analyzed for pesticide analysis using EPA 504 Mod.						

#### B. Metals in Ground Water

Selected ground water samples have been analyzed for metals (Table 3). The maximum metal concentrations from this investigative effort do not indicate a danger to public health or the environment. Arsenic was detected at 10 µg/l; the MCL for arsenic in ground water is 50 µg/l. Lead was detected at 4 µg/l; the MCL for lead in ground water is 50 µg/l. However, additional metals analysis will be performed during the design of the remedy to confirm water quality parameters for treatment and injection to the aquifer.

#### C. TCE and Other VOCs in Ground Water

Ground water contamination was originally detected in the area of OU-2 when the Air Force started sampling local domestic wells in 1986. Sampling of the domestic wells and the installation and sampling of additional monitoring wells in the area yielded the data presented in Table 6. At present there are a total of 39 wells which have been sampled at OU-2 (Figure 3). Of these, 26 are Air Force monitoring wells and the remainder are either private drinking water wells or private irrigation wells. All of these wells are screened in various aquifers. Analytical protocols are presented in Table 3.

The principal contaminant identified in the ground water in the Wallace Road Area is TCE. Other contaminants found, but at lower frequency and lower concentrations are PCE, dibromochloropropane (DBCP), toluene, benzene, ethylbenzene, xylenes, chloromethane, chlorobenzene, 1,2-dichlorobenzene, 1,2-dichloropropane and methylene chloride (Tables 1

and 2). The maximum reported value for TCE in the OU-2 area is 740 µg/l based on water quality monitoring performed by the Air Force. Additional information on TCE and benzene concentrations and their spatial distribution is available from preliminary field screening results of depth-specific sampling in VOC probes (Section V, subsection "Screening Investigations") performed in 1991 (OU-2 RI/FS, January 1992) and the OU-2 Draft Hydrogeological Technical Memorandum (October 1993).

The spatial distribution of TCE within ground water is illustrated in Figure 4. The shallow and subshallow aquifers, based on the present database, have significant TCE concentrations. The confined aquifer has generally non-detect levels based on two monitoring wells (MW601 and MW602) and limited VOC probes. TCE was detected in each well at only one sampling event at a maximum concentration of 1.2 µg/l, less than the MCL of 5 µg/l. No other sampling events detected TCE.

A summary of the concentration range of TCE and the other contaminants identified in ground water in the area of OU-2 is provided in Tables 1 and 2. The results of the quarterly ground water monitoring rounds are presented in Table 6.

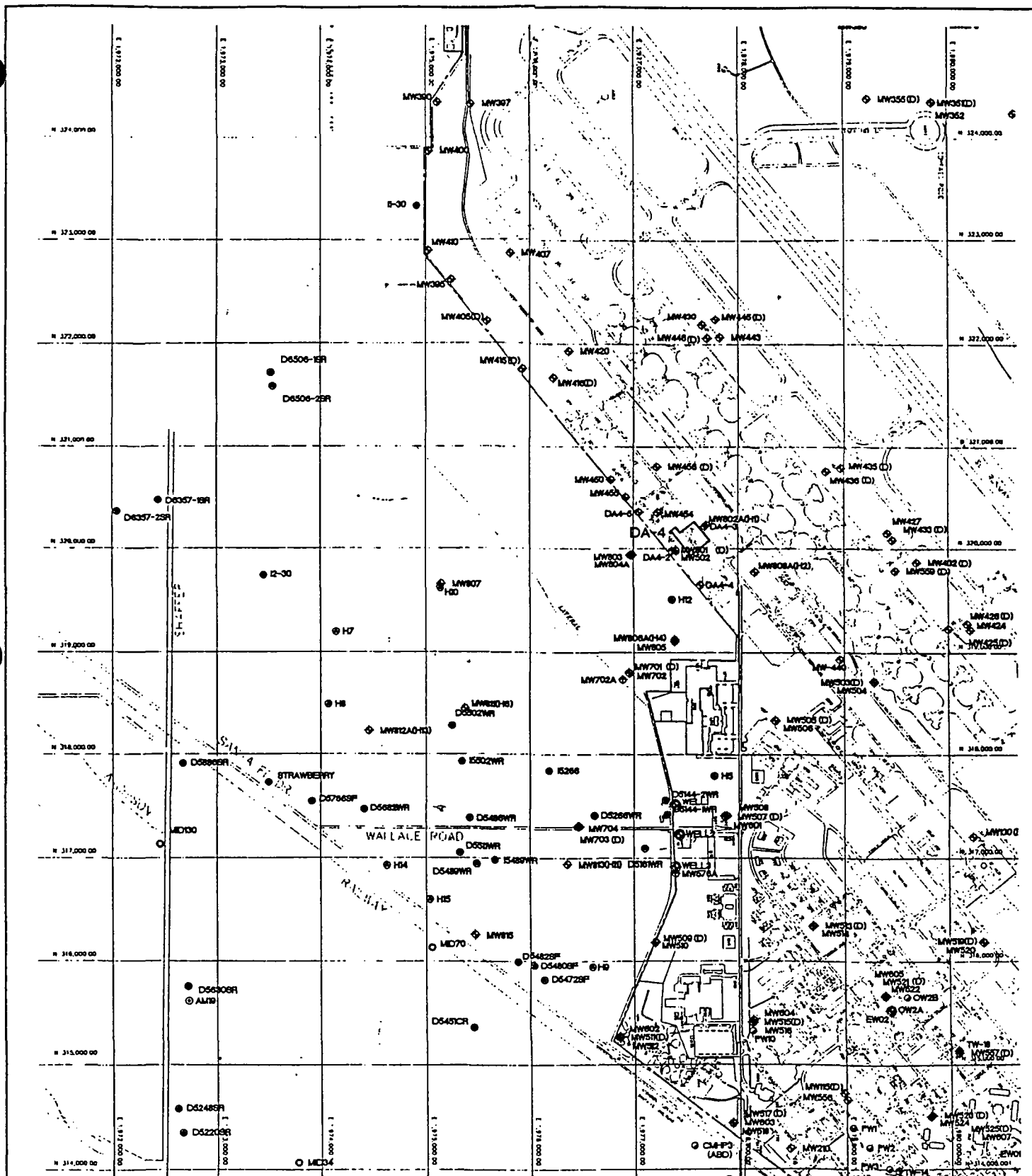
#### D. Screening Investigation

In early 1991 the Air Force conducted an investigative screening effort to determine the horizontal and vertical extent of contamination in ground water. VOC probe sampling is a screening/sampling investigative technique used to obtain ground water samples at varying depths while drilling. The sample integrity is such that the loss of VOCs is minimal. Ground water samples are collected and analyzed in the field to determine when drilling/sampling of a location has been advanced to a sufficient depth for vertical characterization purposes. Fifteen VOC probes were installed in and around the Wallace Road Area and DA-4 in early 1991. A total of 26 VOC probes were drilled Base-wide (HAZWRAF VOC Probe Results for Castle AFB, February 1992). This data was useful in partially characterizing the extent of contamination and in the development of the OU-2 plume characterization (Figure 1).

The area-wide extent of the TCE contaminant plume is partially based on the VOC probe screening investigative results for the upper and lower shallow aquifer and the confined

aquifer. The plume as identified for the lower shallow aquifer is relatively broad-based near the Base boundary. The Wallace Road portion of the plume in each of these aquifer units appears to consist of two lobes, one trending toward the west and the other toward the south.

In early 1993 the Air Force conducted an additional investigative screening effort in the OU-2 area in order to further characterize the vertical and horizontal extent of contamination in ground water and to determine design parameters for the selected remedial action. A total of fifteen Hydropunch borings were installed (OU-2 Hydrogeological Technical Memorandum, October 1993). Seven of these borings were converted to monitoring wells. Four other monitoring wells were also installed. This data was useful in further characterization of the extent of contamination (Figure 1) as well as providing design parameters for the selected remedial action.



# LEGEND

- H8 EXISTING HYDROPUNCH
- MD70 EXISTING IRRIGATION WELL - PUBLIC
- IS502WR EXISTING IRRIGATION WELL -- DOMESTIC
- ◆ MW514 EXISTING MONITOR WELL
- ◆ MW507(D) EXISTING DRY MONITOR WELL
- ◆ MW810(H8) EXISTING MONITOR WELL INSTALLED IN HYDROPUNCH BOREHOLE
- D5266WR EXISTING DOMESTIC WELL
- PW1 EXISTING PRODUCTION WELL
- BASE BOUNDARY



0 600  
SCALE IN FEET



## CASTLE AIR FORCE BASE OPERABLE UNIT 2

AIR FORCE INSTALLATION RESTORATION PROGRAM

LOCATION OF GROUNDWATER WELLS IN THE OU-2 INVESTIGATION AREA

DRAWN BY: KLS

APPROVED BY:

KREFS: CASR22 CASR22 CASR22-0

DATE: 8/4/93

FILE: GWLOC-HY.DWG

FIGURE  
3

REFERENCE:  
JEG  
1993

PROJ. NO.  
21-G430-01





# LEGEND

- H8 HYDROPUNCH LOCATION
- ◆ MW811 MONITOR WELL LOCATION
- ◆ DS266WR DOMESTIC WELL
- ◆ MW810(H8) MONITOR WELL INSTALLED IN HYDROPUNCH BOREHOLE

- BASE BOUNDARY
- 20.00 TCE CONCENTRATION CONTOUR
- 43 TCE CONCENTRATION (ON PPB)



CASTLE AIR FORCE BASE  
OPERABLE UNIT 2

AIR FORCE INSTALLATION RESTORATION PROGRAM

SHALLOW HYDROSTRATIGRAPHIC ZONE  
GROUNDWATER MONITOR WELL TCE RESULTS (PPB)

DRAWN BY: PV

APPROVED BY: XREFSCAS02-0  
CASTLE2 CASPL

DATE: 8/16/93  
FILE: GICS-HI.DWG

FIGURE  
4

REFERENCE:  
JEC  
1993

PROJ. NO.  
21-G430-01

## E. Data Validation

The remedial investigation database was validated in accordance with EPA guidance and meets the objectives of NCP Section 300.430(b)(8)(ii) in that the data quality is sufficient to support the selection of the remedy. All data used in the risk assessment was validated in accordance with EPA Region 9 guidance.

## VI. SUMMARY OF OU-2 RISKS

The risk assessment contained in the RI/FS for OU-2 (January 1992) evaluates the public health and environmental risks posed by VOCs at OU-2. TCE is the primary chemical of concern at OU-2; however, numerous other VOCs have been detected in the ground water at both DA-4 and the Wallace Road Area. It was also considered that TCE-breakdown-products such as vinyl chloride may also be present in OU-2. Therefore, samples were specifically analyzed for vinyl chloride in addition to the other VOCs. No vinyl chloride was detected. In accordance with U.S. EPA, Region IX Risk Assessment Guidance, chemicals which were detected in fewer than five percent of the samples analyzed for OU-2 were eliminated from consideration in the quantitative risk assessment. Following the screening process, the constituents below were considered in the baseline risk assessment as chemicals of concern:

Chloroform	Xylenes
Chloromethane	Toluene
Tetrachloroethylene (PCE)	Ethylbenzene
Trichloroethylene (TCE)	Benzene
Cis-1,2-dichloroethylene	Chlorobenzene

### Human Health Risk

Potential exposed populations at and near OU-2 include residences, on-site workers, visitors or trespassers who might come in contact with the contaminated ground water, and off-site workers or residents who might come in contact with the contaminated ground water. Because residential development is located on part of OU-2 and because there is a possibility of residential development of the base after closure, risks for OU-2 have been evaluated assuming a future residential exposure scenario.

Potential exposure pathways identified in the risk assessment included ingestion of contaminated ground water, inhalation of vapor-phase chemicals while showering with contaminated ground water, and inhalation of

vapor-phase chemicals from spray irrigation with ground water. Conservatively, to assure that risks were not underestimated, the highest concentration of each chemical of concern observed was used as the exposure point concentration. In calculating the exposure for 30 years for an adult the risk assessment assumed a body weight of 70 kg, consumption of two liters of water per day. Further detail regarding risk assessment assumptions can be found in the RI/FS for OU-2 (January 1992) Section 7.

The risk assessment concluded that the excess lifetime cancer risks, assuming residential use of contaminated ground water and spray irrigation (ingestion and inhalation) located at OU-2, for all chemicals of concern, is estimated at  $1.99\text{E}^{-02}$  (adult) and  $1.83\text{E}^{-02}$  (child). The major contributor to risk was TCE exposure through inhalation while showering. Risk associated with ground water ingestion and inhalation exceeded the range generally considered to be acceptable by EPA ( $1.0\text{E}^{-4}$  to  $1.0\text{E}^{-6}$ ) pursuant to the NCP, 40 C.F.R. Section 300.430(e)(2)(i)(A)(2). Additionally, TCE is a known carcinogen and is present in the ground water at levels that significantly exceed the federal and California drinking water standards for this chemical. Drinking water (chemical-specific) standards are health-based levels and may be used to determine whether remediation is warranted.

Seventeen volatile organic compounds (Tables 1 and 2) have been detected in the ground water in the area of OU-2. Ten were determined to be present at levels which could pose health risks (refer to Section VI, Summary of OU-2 Risks). Trichloroethylene (TCE) is the most prevalent and mobile contaminant, and is therefore determined to be an indicator chemical. The risk assessment contained in the RI/FS for OU-2 identifies TCE as the major contributor to health risks. The VOC chemicals which will be remedied in OU-2 are trichloroethylene (TCE), tetrachloroethylene (PCE), and benzene. While some lower health risk will remain due to remaining residual contamination from the VOCs, reducing the level of contamination of TCE, PCE and benzene to Maximum Contaminant Levels (MCLs) will lower risks to an acceptable range ( $1.0\text{E}^{-4}$  to  $1.0\text{E}^{-6}$ ).

EPA considers the results of the baseline risk assessment and compares OU-2 concentrations to chemical-specific standards to assess whether there is an unacceptable risk to human health or the environment in making the decision as to whether remediation at a site is appropriate. EPA has determined that the ground water contamination at OU-2 poses an unacceptable risk to human health because ground water at OU-2 (1) is a drinking water source that contains carcinogens and if unabated poses an excess risk of more than  $1.0\text{E}^{-4}$  to  $1.0\text{E}^{-6}$  and (2) exceeds federal and state drinking water standards (Tables 5A and 5B). The risk calculation for ground water is summarized below.

#### SUMMARY OF CARCINOGENIC RISKS

Exposure Pathway	Adult	Child
Ingestion	$7.56\text{E}^{-04}$	$3.52\text{E}^{-04}$
Inhalation/Vapors	$1.91\text{E}^{-02}$	$1.79\text{E}^{-02}$

Irrigation/Vapors	3.91E <sup>-06</sup>	3.65E <sup>-06</sup>
Total Pathway Risk	1.99E <sup>-02</sup>	1.83E <sup>-02</sup>

#### SUMMARY OF NON-CARCINOGENIC HAZARD

Exposure Pathway	Adult	Child
Ingestion	4.48E <sup>-02</sup>	1.05E <sup>-01</sup>
Inhalation/Vapors	1.29E <sup>-01</sup>	6.00E <sup>-01</sup>
Irrigation/Vapors	2.63E <sup>-05</sup>	3.75E <sup>-05</sup>
Total Pathway Hazard	1.74E <sup>-01</sup>	7.05E <sup>-01</sup>

#### Environmental Risk

Table 3-A illustrates the Federally and/or State-Listed species potentially occurring in the region of Castle AFB. Although the presence or absence of these species is being determined at the Base, potential exposure to ground water in the OU-2 area is judged to be less than that estimated for humans in the future residential scenario.

Table 3-A. Federally or State-Listed Species Potentially Occurring in the Region of Influence of Castle AFB

Name	Federal Status	State Status	CNPS	Habitat and Distribution
<b>PLANTS</b>				
Henderson's bentgrass ( <i>Agrostis microphylla</i> var. <i>hendersoni</i> )	C2	-	3	Occurs in vernal pools and in valley and foothill grassland. Known to occur east of Castle AFB.
Hoover's rosinweed ( <i>Calycadenia hooveri</i> )	C2	-	1 B	Occurs in valley and foothill grassland, cismontane woodlands. Known from various locations within Merced County.
Beaked clarkia ( <i>Clarkia Rostrata</i> )	C2	-	1 B	Occurs in valley and foothill Grassland, cismontane woodland. Known to occur northeast of Castle AFB.
Colusa grass ( <i>Neostapha colusana</i> )	C1	E	1B	Occurs in vernal pools. Known to occur near Castle AFB.
San Joaquin orcutt grass ( <i>Orcuttia inaequalis</i> )	C1	E	1 B	Occurs in vernal pools. Known to occur northwest of base. Considered likely to occur at Castle AFB.
Pilose orcutt grass ( <i>Orcuttia pilosa</i> )	C1	E	1B	Occurs in vernal pools. Known to occur in areas north and west of base. Considered likely to occur at Castle AFB.
Fleshy owl's clover ( <i>Orthocarpus campestris</i> var. <i>succulentus</i> )	C2	E	1B	Occurs in vernal pools. Known to occur east and west of base. Considered likely to occur at Castle AFB.
Merced phacelia ( <i>Phacelia ciliata</i> var. <i>opaca</i> )	C2	-	1 B	Occurs on clay soils in a variety of habitats, although primarily in valley and foothill grassland. Known to occur southeast of base. May occur at Castle AFB.
Green's tuctoria ( <i>Tuctoria greenei</i> )	C1	R	1 B	Occurs in vernal pools. Known to occur northwest of base. Considered likely to occur at Castle AFB.

Federally or State-Listed Species Potentially Occurring in the Region of Influence of Castle AFB

Name	Federal Status	State Status	CNPS	Habitat and Distribution
<b>ANIMALS</b>				
<b>Invertebrates</b>				
Valley elderberry longhorn beetle ( <i>Desmocerus californicus dimorphus</i> )	T	-	-	Larvae are stem and root borers of elderberry. Adults feed on its foliage and flowers. Not expected to occur at Castle AFB due to absence of elderberry trees.
Vernal pool fairy shrimp ( <i>Branchinecta lynchi</i> )	PE	-	-	May inhabit vernal pools on Castle AFB.
Vernal pool tadpole shrimp ( <i>Lepidurus packardii</i> )	PE	-	-	May inhabit vernal pools on Castle AFB.
Conservancy fairy shrimp ( <i>Branchinecta conservatio</i> )	PE	-	-	May inhabit vernal pools on Castle AFB.
California linderiella ( <i>Linderiella occidentalis</i> )	PE	-	-	May inhabit vernal pools on Castle AFB.
<b>Amphibians</b>				
California tiger salamander ( <i>Amhyostoma californiense</i> )	C2	CSC	-	Breeds in temporary pools and permanent waters of grassland and open woodland of low hills and valleys; eliminated from much of its former Central Valley range by agriculture and urban developments. Suitable habitat occurs on Castle AFB.
<b>Reptiles</b>				
Blunt-nosed leopard lizard ( <i>Gambelia silus</i> )	E	E	-	Occurs in scattered locations, inhabits sparsely vegetated plains and semi-arid grasslands. Castle AFB is within distribution of species and contains marginal habitats. Not expected to occur on Castle AFB.

Federally or State-Listed Species Potentially Occurring in the Region of Influence of Castle AFB

Name	Federal Status	State Status	CNPS	Habitat and Distribution
Giant garter snake ( <i>Thamnophis gigas</i> )	PE	T	-	Occurs in streams and sloughs, usually with mud bottoms, range includes floor of Central Valley from Delevan National Wildlife Refuge in Colusa County to Los Banos Creek and Mud Slough in San Joaquin Valley. Castle AFB is outside the normal range of this species. Further, it would not be expected on base due to dredging of drainage ditches which are the only permanent aquatic habitat on base.
Southwestern pond turtle ( <i>Clemmys marmorata pallida</i> )	C1	CSC	-	Found in rivers, ponds, and ditches with permanent water flow, usually in woodland, grassland, and open forest. Castle AFB is outside the normal range of this species. Further, it would not be expected on base due to dredging of drainage ditches which are the only permanent aquatic habitat on base.
<b>Birds</b>				
American peregrine falcon ( <i>Falco peregrinus anatum</i> )	E	E	-	Rare and local, nests on Protected ledges of high cliffs and forages primarily in coastal and inland marshes and riparian areas. Nesting habitat is not present in the vicinity of Castle AFB but breeding does occur in Yosemite National Park.
Aleutian Canada goose ( <i>Branta canadensis leucopareia</i> )	E	-	-	Winter visitor or migrant in Central Valley of California. Feed in wetlands, grasslands, and cultivated fields during migrations. Vernal pools on Castle AFB could offer some suitable habitat.

Federally or State-Listed Species Potentially Occurring in the Region of Influence of Castle AFB

Name	Federal Status	State Status	CNPS	Habitat and Distribution
Loggerhead shrike ( <i>Lanius ludovicianus</i> )	C2	-	-	Fairly common and inhabits open grassland and pastures. Observed during September 1992 field visit.
Tricolored blackbird ( <i>Agelaius tricolor</i> )	C2	-	-	Habitat includes cattail and tule marshes; forages in grasslands and agricultural areas. No suitable nesting/roosting habitat on base, though foraging habitat is present.
<b>Mammals</b>				
San Joaquin kit fox ( <i>Vulpes macrotis mutica</i> )	E	R	-	Occurs from the southern end of the San Joaquin Valley in Contra Costa County along the western foothills and Interior coastal range valleys. Castle AFB is within historic range of kit fox though it is outside of its current distribution. Grassland habitat on base would be suitable for kit fox if this species' distribution expanded and other competitive fox species (red fox) were not a threat.
Fresno kangaroo rat ( <i>Dipodomys nitratoides exilis</i> )	E	E	-	Restricted to alkali sinks in Fresno County in the vicinity of Kerman. Castle AFB is outside the present distribution of this species.
Pacific western big-eared bat ( <i>Plecotus townsenii</i> )	C2	CSC	-	Occurs in rural areas and is most common in moist sites. Habitat must include appropriate roosting sites (i.e., caves, tunnels, or abandoned buildings), which are not found on or near Castle AFB.



Federally or State-Listed Species Potentially Occurring in the Region of Influence of Castle AFB

Name	Federal Status	State Status	CNPS	Habitat and Distribution
Greater western mastiff-bat ( <i>Eumops perotis californicus</i> )	C2	CSC	-	Prefers rocky canyons and creviced cliffs and is an uncommon resident in the San Joaquin Valley. This species will roost in tall, buildings, trees, or tunnels. This species is unlikely to be present on base .

Notes: *Federal status:*

- E = Listed as Endangered by the U.S. Fish and Wildlife Service (USFWS)
- PE = Proposed as Endangered by the USFWS.
- T = Listed as Threatened by the USFWS.
- C1 = Category 1 candidate for federal listing. (Taxa for which The USFWS has sufficient biological information to support a proposal to list as Endangered or Threatened.)
- C2 = Category 2 candidate for federal listing. (Taxa which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.)
- 2R = "Recommended" for Category 2 status by the USFWS.

*California status:*

- E = Listed as Endangered by the State of California.
- T = Listed as Threatened by the State of California.
- R = Listed as Rare by the State of California.
- CSC = California Department of Fish and Game "Species of Special Concern".

*California Native Plant Society (CNPS) status:*

- 1 B = Plants listed as Rare Threatened or Endangered in California and elsewhere.
- 3 = Plants about which we need more information - a review list.

## Risk Summary

Release of hazardous substances from OU-2 has resulted in the contamination of ground water that presents an imminent and substantial endangerment to public health, welfare or the environment if the releases from OU-2 are not addressed by implementing the remedial response action selected in this ROD. The removal action at DA-4 and Wallace Road may reduce OU-2 risks, however, ground water contamination remains beneath OU-2 which exceeds drinking water standards and requires remedial action.

## VII. DESCRIPTION OF ALTERNATIVES

This section describes the six alternatives evaluated by the OU-2 RI/FS in selecting the final cleanup plan for OU-2. The FS presented and compared the six alternatives using nine criteria required by the NCP (40 C.F.R. Sec. 300.430(e)(9)) in the Feasibility Study. The nine criteria are:

- overall protection of human health and the environment,
- compliance with applicable or relevant and appropriate requirements (ARARs).
- long-term effectiveness and permanence,
- reduction of toxicity, mobility, or volume through treatment,
- short-term effectiveness,
- implementation,
- cost,
- state acceptance, and
- community acceptance.

These criteria are categorized into three groups in accordance with the NCP §300.430(f)(1)(i)(A), (B) and (C):

- (1) The threshold criteria: the overall protection of human health and the environment; and compliance with applicable or relevant and appropriate requirements. Each alternative must meet the threshold criteria in order to be eligible for selection.
- (2) The primary balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

(3) The modifying criteria: both state and community acceptance are modifying criteria that shall be considered in remedy selection.

The nine criteria are described in more detail in Part VIII ("Summary of Comparative Analysis of Alternatives"), and in Table 4.

The focus of the Feasibility Study was on the achievement of the drinking water standards in ground water at the end of the remedial action. The aquifers underlying DA-4 and Wallace Road are designated by the State of California as sources of drinking water and therefore must be restored to drinking water quality standards. The federal and State drinking water standards for the chemicals, for which aquifer standards have been developed are presented in Tables 5-A and 5-B. The alternatives described below, except the no-action alternative, employ different approaches but are designed to meet these standards in the aquifer over the indicated time periods.

Each alternative would require periodic ground water monitoring to determine the effectiveness of the clean-up and to verify achievement of the clean-up standards. The details of the specific ground water monitoring program will be determined during remedial design, using information from the operating removal action. Effectiveness of the selected remedy will be illustrated through implementation of the Long term Groundwater Sampling Plan.

#### No-Action Alternative

The NCP requires that a no-action alternative be considered at each site or operable unit. The no-action alternative serves primarily as a point of comparison to other alternatives. Continued groundwater monitoring is the cost associated with this alternative. No active treatment systems would be implemented in this alternative. As demonstrated by the risk assessment for OU-2, this alternative is not acceptable since it would not result in overall protection of human health or the environment.

#### Alternative I

Alternative I would not provide any treatment or extraction of contaminated ground water. Instead, Alternative I, based on institutional controls, depends on natural attenuation of the VOCs to meet the cleanup levels. The institutional controls to be used under this alternative are imposing deed restrictions to prevent contact with the contaminated ground water and providing city water to the affected residents during the period of natural attenuation. This alternative also includes using existing monitoring wells to track the direction and rate of movement of the plume.

Alternative I provides no near-term reduction in risk to human health posed by the contaminated ground water. It allows for the possible continued migration of the contaminant plume and further degradation of the ground water. The carcinogenic risk resulting from this alternative is  $1.99E^{-02}$  (adult).

The long-term reliability of institutional controls to prevent use of the contaminated ground water is problematic. Therefore, all current and potential future risks are assumed to remain under this alternative.

This alternative provides no reduction in toxicity, mobility, or volume of the contaminated ground water through treatment. There would be additional risks posed to the community and the environment as a result of this alternative being implemented since the contaminant plume would continue to spread. As the plume spreads, more wells are likely to become impacted.

It is estimated that the annual operation and maintenance (O&M) cost for Alternative I is \$30,000. This cost occurs in each of the remaining four alternatives examined in this detailed analysis since on-going monitoring of the contamination plume is required in each case. This cost reflects on-going sampling and analytical activities.

#### Alternative II -- Packed Tower Air Stripper

In this alternative, the ground water would be pumped from the shallow Aquifer and treated in a packed tower air stripper. Treated water would be injected into the same aquifer. The contaminated ground water is introduced into the top of the tower by distribution nozzles and allowed to flow by gravity over a bed of packing material to a clearwell at the bottom. Packing material occupies the majority of the height of the tower above the clearwell. The choice of the packing would be designed to maximize surface area and to enhance air-water contact while minimizing the air pressure drop through the tower and be cost effective. Air traveling countercurrent to the water would be forced into the bottom of the tower by a blower, and would exit at an exhaust port at the top. As the air moves through the tower, TCE and other VOCs would be stripped from the water and transferred to the vapor phase.

Carbon adsorption is the technology chosen to reduce air emissions by 95% or more as required by the San Joaquin Valley Unified Air Pollution Control District (APCD). Monitoring would be required to determine the breakthrough point of the carbon vessels. Initially, the sampling frequency for the carbon vessels would be once a week. This frequency would be reduced once a time frame for breakthrough is established. The use of carbon adsorption as the emission control system requires regeneration or disposal of the spent carbon. The volume of carbon required for air phase removal of TCE and other VOCs is considerably less than that required for water phase removal. The change-out frequency for the vapor phase carbon system is estimated to be approximately once every three months.

Scale prevention must be considered as part of the design of the air stripper. Due to levels of hardness and alkalinity in water samples collected from the shallow aquifer, scaling of the tower packing during operation

is likely. This phenomenon occurs when carbon dioxide ( $\text{CO}_2$ ) is stripped from the water along with the TCE (and other VOCs). The stripping of  $\text{CO}_2$  increases the pH of the water, resulting in precipitation of calcium carbonate. A continuous acid addition system would not be necessary; however, semiannual acid washing of the tower would be performed, with acid neutralization of the waste prior to discharge to the Base sewer. A scheduled shutdown would be required approximately once every six months for this purpose.

In this alternative, as with all the treatment alternatives (Alternatives II through V), the treated effluent is injected into the shallow aquifer using recharge wells. Injection of the treated waste stream is the chosen technology for disposal of treated ground water that meets effluent limits established in this ROD. By injection, depletion of the aquifer by the selected remedy is prevented. The method proposed for injection would entail the construction of injection wells screened in the shallow aquifer in which the injected water would be fed into the aquifer by gravity flow via the injection wells. The optimum location and number of wells and well injection rates would be based on a hydraulic evaluation using ground water flow modeling simulation and best professional judgement.

Monitoring of ground water flow conditions resulting from the combined effects of injection and extraction would entail water level measurements in monitoring wells located in the plume. Injection well performance in terms of maintaining selected injection rates would be evaluated quarterly. The evaluation would be based on measured injection rates and measured water level head build-up in each of the injection wells. An established performance criterion, for each injection well, as determined by aquifer testing at the time of well construction, development and subsequent ground water level monitoring, would be used to determine the need for modification to the injection rate and/or the need for servicing the well to maintain performance levels as established at the time of operations start-up.

Alternative II would be protective of both human health and the environment. Ground water extraction and treatment would reduce the threat to human health by ingestion of contaminated ground water, and reduce the possibility of further environmental degradation. The aquifer treated by this alternative would meet the federal and state promulgated maximum contaminant levels (MCLs) for TCE and the other contaminants identified as part of OU-2. The carcinogenic risk resulting from this alternative is  $6.73\text{E}^{-07}$  for ingestion of  $5\text{ }\mu\text{g/l}$  TCE in ground water and  $1.70\text{E}^{-05}$  for inhalation of TCE vapors while showering. The showering scenario assumes a TCE concentration of  $5\text{ }\mu\text{g/l}$  in ground water.

The air emissions from the treatment system would be minimal with the addition of the air emission control system. The off-gases from the packed tower air stripper would be filtered by granular activated carbon (GAC). GAC filtration is considered Best Available Control Technology (BACT) and is one of the more effective means to capture volatile organic compounds. With this treatment air emissions will be negligible. This alternative will meet all air emission ARARs developed under the California Mulford-Carrell Resources Act, as administered by the San Joaquin Valley Unified APCD.

To provide for long-term effectiveness of this alternative, careful maintenance of the controls would be needed. Human health risks posed by dermal contact, ingestion, and inhalation of ground water in the future would be reduced. To determine its long-term effectiveness, the air stripper would be monitored under a long-term program. Any modifications to the system would be based on evaluation of monitoring results.

The air stripper will reduce the toxicity, mobility, and volume of TCE and other VOCs in ground water. TCE and other VOCs would be removed from the pumped water by treatment with an air stripper. Contaminants in the air stream will be minimal due to the air emissions control system.

Alternative II meets the statutory preference for using treatment as a principal element since the principal threat is addressed through treatment. Safety techniques, including monitoring the equipment, will be used to minimize any failures of the components. Once the extraction and air stripper systems are installed, the contaminant plume will begin to recede from its current position. There are no additional risks to the community in the short-term. An approved health and safety plan will be implemented for workers who may come in contact with contaminated ground water. The time required to achieve MCLs in the ground water (in situ) is approximately 16 years.

This alternative involves the use of a proven technology. Air stripper treatment uses equipment that is readily available. Operators are also readily available and easily trained. Operation of this alternative would require monitoring of the ground water and the treated effluent to assess the effectiveness of the air stripper. Controlling the operating conditions would be necessary to maintain the effectiveness of this system. Engineering judgment would be required during operation to determine the operating parameters, such as air flow rate in the air stripper and VOC contamination in the exhaust gas. The system could be easily modified if additional contaminants were detected.

The capital cost for Alternative II is estimated to be \$340,000 with projected annual O&M costs of \$290,000.

### Alternative III -- Steam Stripper

Steam stripping is a conventional method of removing gases or volatile organics from water. The technology of steam stripping is essentially fractional distillation with steam as the energy source.

The feed water is first heated in a heat recovery heat exchanger prior to being introduced into the top of the tower. Nozzles distribute the water across the packing where it is allowed to flow by gravity to the reboiler at the bottom of the tower. Additional heat is imparted to the waste stream by an external loop of boiler steam in the reboiler.

Heating of the feed liquid occurs at two points in the process. The first point is prior to entering the tower by a heat exchanger; the second is in the bottom of the tower by an external loop of steam. The vapor produced then rises through the tower, countercurrent to the water, and enters a reflux condenser at the top. As

the steam rises through the tower, the TCE (including the other VOCs) concentration in the vapor phase increases and that in the water phase decreases. The reflux condenser receives the concentrated TCE/water (and VOC/water) vapor and condenses the mixture into a separator built into the condenser. The contaminants drop to the bottom of the separator and the water rises to the top. The water is returned to the tower for further treatment and the liquid TCE (and VOCs) is removed from the bottom of the separator.

Like air stripping, this alternative would require air emission control due to regulations of the San Joaquin Valley Unified APCD. Carbon adsorption is the technology of choice. Approximately one 55-gallon drum of spent carbon is expected to be generated per month. It would also be necessary to dispose of the TCE/water solution removed from the bottom of the separator. This solution is expected to contain a 9:1 ratio of TCE to water.

Scale prevention would be addressed as part of the design of the steam stripper. Based on the hardness and alkalinity of ground water in the shallow aquifer, scaling of the tower packing is likely. A continuous acid addition system would be required since scaling would pose a problem in the performance of the steam stripper.

As described for Alternative II, the treated effluent in Alternative II is injected into the shallow aquifer using wells. Identical monitoring of well performance will be conducted as for Alternative II.

Alternative III would be protective of both human health and the environment. The assessment for this alternative is very much like the assessment for Alternative II.

Long-term monitoring would be necessary to evaluate the effectiveness of the system. There would be no additional risks to the community in the short-term for this alternative. An approved health and safety plan will be implemented for workers who may come in contact with contaminated ground water. The areal extent and the contaminant levels within the plume are expected to decrease once this alternative is operational. The carcinogenic risk resulting from implementation of this alternative is  $6.73\text{E}^{-07}$  for ingestion of  $5\text{ }\mu\text{g/l}$  TCE in ground water and  $1.70\text{E}^{-05}$  for inhalation of TCE vapors while showering. The showering scenario assumes a TCE concentration of  $5\text{ }\mu\text{g/l}$  in ground water. The time required to achieve MCLs in the ground water (in situ) using Alternative III is approximately 16 years.

The steam stripping system would reduce the toxicity, mobility and volume of TCE in ground water. Steam stripping emission control is a proven technology for treatment of VOCs and equipment is readily available. A steam supply is required and some specialized operator training may be required due to the use of high-pressure steam. Carbon from the air emission control system will have to be replaced or regenerated on a regular basis. The TCE/water (VOCs/water) condensate will also have to be disposed or recycled. The capital cost is approximately \$1,400,000 with annual O&M costs of \$780,000.

#### Alternative IV -- Carbon Adsorption

Liquid phase carbon adsorption is frequently used for water purification applications. Contaminants are adsorbed onto granular activated carbon (GAC) as ground water is passed through a filter bed. GAC is well suited for removal of VOCs.

The key parameter for GAC adsorption is the carbon requirement. TCE, and other VOCs, once adsorbed, remain in the carbon. Eventually, all adsorption sites on the GAC would be filled with molecules of the OU-2 contaminants, saturating the carbon bed. Breakthrough would occur when contaminants passed through the GAC filter bed unadsorbed. Normally, two GAC vessels are used in series to ensure adequate treatment after there is breakthrough in the first column.

Adsorption can occur as long as the concentration of TCE (and other VOCs) at the surface of the carbon is less than the corresponding equilibrium contaminant concentration in the passing liquid. Once the liquid concentration drops below the surface equilibrium concentration, contaminants will not be adsorbed. This poses problems in applications where the contaminant concentration varies or declines over time, and the effluent must be closely monitored to identify the occurrence of breakthrough.

The conditions at OU-2 are such that a four-vessel system would be best suited for the desired treatment. Four 10,000-pound capacity vessels, two in parallel, two in series, are recommended to provide sufficient treatment capacity. The 700-gpm extraction stream would be divided into two 350-gpm streams through two vessels. Since injection of the treated effluent into the shallow aquifer is highly favored, it would be necessary to closely monitor effluent from the first vessel of the treatment system to determine when replacement is required.

The carbon requirement is an estimate based on an assumed influent concentration. As the influent concentration changes, the amount of carbon required for adsorption of contaminants also changes. As influent concentrations decrease, the usable life of a carbon vessel can be expected to increase. Carbon adsorption capacity varies among different suppliers. A carbon consumption rate of approximately 500 pounds of carbon/day has been estimated for the treatment of contaminated ground water at OU-2.

The capacity of the GAC adsorption system described is approximately one million gallons per day, based on a 700-gpm pumping rate.

As described for Alternatives II and III, the treated effluent would be injected into the shallow aquifer using recharge wells. Similar monitoring of well performance would occur as described for Alternatives II and III.

Alternative IV is protective of both human health and the environment. The assessment for this alternative is very much like the assessment for Alternatives II and III. This alternative would allow the MCLs for the OU-2 contaminants to be achieved. There are no air emissions with the carbon adsorption system. Alternative IV would also meet all other ARARs.



Long-term monitoring would be necessary to determine the effectiveness of the system. Additional monitoring would be required with the carbon adsorption system to determine when breakthrough of the first carbon vessel occurs. The additional monitoring would initially occur on a weekly basis.

Alternative IV presents no additional short-term risk to the community. An approved health and safety plan would be implemented to protect workers who might come in contact with contaminated ground water. The areal extent of the plume will begin to decrease once Alternative IV is implemented. The carcinogenic risk resulting from this alternative is  $6.73E^{-07}$  for ingestion of  $5\text{ }\mu\text{g/l}$  TCE in ground water and  $1.70E^{-05}$  for inhalation of TCE vapors while showering. The showering scenario assumes a TCE concentration of  $5\text{ }\mu\text{g/l}$  in ground water. The time required to achieve MCLs in ground water (in situ) is approximately 16 years.

The carbon adsorption system would also reduce the toxicity, mobility, and volume of OU-2 contaminants in ground water; however, the disposal of contaminated carbon would have to be arranged through a contractor. Carbon adsorption has a removal efficiency of near 100% prior to breakthrough.

Carbon adsorption is a proven technology for treatment of VOCs and equipment is readily available. Operators are readily available and easily trained. The capital cost is estimated to be \$500,000 with annual O&M costs of \$700,000. O&M costs also include annual replacement of GAC.

#### Alternative V -- Catalyzed Chemical Oxidation

Chemical oxidation refers to the chemical reaction that occurs when an oxidant, such as hydrogen peroxide, reacts with the contaminant to reduce the oxidation state of the reactant. In the case of TCE, a chlorinated molecule, the reaction proceeds through a series of intermediate steps to produce water, carbon dioxide and free chloride ions. These residual products are oxidized states of the TCE molecule. The other OU-2 contaminants are also effectively oxidized in this process.

Catalyzed chemical oxidation consists of catalyzing ultraviolet (UV) radiation and chemical oxidation using hydrogen peroxide. The combination induces rapid photochemical oxidation of halogenated organic compounds. The process takes place in a UV/oxidation reactor operated on a continuous-flow basis. A 400-600 kilowatt reactor is recommended.

As described in Alternatives II, III and IV, the treated effluent would be injected into the shallow aquifer using recharge wells. The treatment system proposed in Alternative V would be monitored. Well performance would be evaluated as in Alternatives II, III, and IV.

Catalyzed chemical oxidation can provide protection to human health and the environment since it essentially destroys TCE on-site, and does not generate secondary wastes requiring further treatment. For this reason, it is very effective in reducing toxicity, mobility, and volume of contaminants. Catalyzed chemical oxidation has the capability to reduce toxic levels of TCE in ground water to the MCL. The carcinogenic risk resulting from this alternative is  $6.73E^{-07}$  for ingestion of  $5\text{ }\mu\text{g/l}$  TCE in ground water and  $1.70E^{-05}$  for inhalation of TCE vapors while showering. The showering scenario assumes a TCE concentration of  $5\text{ }\mu\text{g/l}$  in

ground water. There are no contaminated air emissions with the chemical oxidation system. Alternative V would also meet all other ARARs. The chemical oxidation process system is readily implemented since it is portable and requires no extensive design.

There are no additional short-term risks to the community with the implementation of Alternative V. Protection of workers who may come in contact with contaminated ground water will be afforded through the implementation of an approved health and safety plan. The areal extent of the plume would decrease once the treatment system proposed in Alternative V was operable and would take approximately 16 years for ground water cleanup standards (MCLs) to be met.

The equipment for catalyzed chemical oxidation can be readily obtained from commercial vendors. More specialized operator training is required for Alternative V than for the other alternatives. Addition of specific doses of chemicals is required for this alternative. It is estimated that capital costs, which includes the initial purchase of the equipment and installation, are \$500,000. It is estimated that O&M costs are \$340,000 per year.

## VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The five alternatives presented in Section VII are evaluated below in relation to one another for each of the evaluation criteria. This analysis will identify the advantages and disadvantages of each alternative. Table 4 is a summary of the comparative analysis.

### A. Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether an alternative provides adequate protection from exposure to contamination and describes how risks for the exposure pathways are eliminated or reduced.

The no-action alternative would not provide any protection from exposure to ground water contamination at OU-2 and there would be no reduction of OU-2 associated risk. Alternative I would not actively eliminate or reduce risks posed by ground water contamination and could result in the contamination spreading. Ground water monitoring would measure the effects of possible natural processes such as degradation and attenuation; however, these processes are uncertain and provide virtually no protection against existing risks.

Alternatives II, III, IV and V, through the use of engineering controls (in the form of a ground water extraction and treatment system) would protect against the spread of contaminated ground water and reduce the risk of exposure. The treatment method selected will allow clean-up of the in situ ground water to comply with ARARs.

## B. Compliance with ARARs

Section 121(d) of the CERCLA, 42 U.S.C. Section 9621(d), requires that remedial actions selected under CERCLA attain a level or standard of control of the hazardous substances at a site or operable unit which complies with "applicable or relevant and appropriate requirements" (ARARs). ARARs are derived from federal and more stringent state environmental and facility siting laws that have been identified by the state in a timely manner.

"Applicable" requirements are those cleanup standards, standards of control, and other substantive requirements or limitations that have been promulgated under federal or state environmental and facility siting laws that specifically address a hazardous substance, pollutant or contaminant, remedial action or other circumstance at a particular CERCLA site or operable unit. "Relevant and appropriate" requirements are cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not directly applicable to a hazardous substance, pollutant or contaminant, remedial location or other circumstance at a CERCLA site or operable unit, address problems or situations sufficiently similar to those encountered at the particular site or operable unit that their use is well suited to the particular site. If an ARAR is determined to be insufficient to protect human health or the environment, non-promulgated advisories or guidance (To Be Considered or TBCs) may be used in determining the necessary cleanup level for protection of human health or the environment.

There are three categories of ARARs or TBCs: (1) chemical-specific, (2) action-specific and (3) location-specific. Chemical-specific ARARs and TBCs are limits on concentrations of specific hazardous substances, pollutants or contaminants in the environment. Examples of this type of requirement are drinking water standards and ambient water quality criteria. Action-specific ARARs and TBCs are restrictions that are triggered by a particular type of activity at a site or operable unit, such as Resource Conservation and Recovery Act (RCRA) regulations regarding hazardous waste treatment, storage or disposal. Location-specific ARARs or TBCs are restrictions on certain types of activities based on the location of the Site or operable unit. These include restrictions on activities in wetlands, floodplains and historic areas.

A detailed analysis of ARARs for this ROD is presented in Tables 5-A and 5-B. A partial narrative description of ARARs follows.

### Chemical-Specific ARARs

A total of 10 contaminants were identified for evaluation in the risk assessment (see Section VI "Summary of OU-2 Risks"). The combined risk from these contaminants exceeded EPA's acceptable risk range (i.e.,  $1.0E^{-4}$  to  $1.0E^{-6}$ ) for all exposure pathways. Additionally, three of these contaminants (TCE, tetrachloroethylene,

and benzene) exceed their respective federal or state MCLs (Tables 5-A and 5-B) and present an unacceptable risk to human health.

The State has asserted that Title 23 of the CCR, Division 3, Chapter 15, Article 5 is an ARAR for this site requiring clean-up of the aquifer to background unless it is technologically or economically infeasible to do so. All parties to the FFA have not agreed that Chapter 15 is an ARAR in this case. Therefore, the contaminant specific ARARs for the OU-2 aquifer clean-up are the Federal or more stringent State of California drinking water standards because the site or operable units ground water is a potential source of drinking water. The aquifer clean-up levels for the constituents of concern are therefore established at the following levels: TCE, 5ppb (federal MCL); PCE, 5 ppb (federal MCL); and benzene, 1 ppb (state MCL). The Air Force agrees to conduct studies to assess the technical and economic feasibility of achieving background (at the analytical detection limit of 0.5 ppb for TCE), the one-in-one million cancer risk established in the EPA's Integrated Risk Information System (3.0 ppb for TCE) and the MCL (5 ppb for TCE) for these constituents of concern and will evaluate more stringent aquifer standards during the Comprehensive Base-wide FS. The alternative clean-up standards will be considered by all parties at that time.

With the exception of the "No Action" alternative and alternative I, all of the alternatives will achieve the chemical specific ARARs. For alternatives II through V, MCLs are estimated to be achievable in 16 years.

#### Action-Specific ARARs

##### Injection of Treated Effluent into the Aquifer

Alternatives II through V include ground water extraction, treatment and injection of treated effluent into the same aquifer. Effluent from the ground water treatment system that is injected into the aquifer at OU-2 must meet the following ARARs: (1) the federal Underground Injection Control (UIC) Program for class V wells set forth in 40 C.F.R. Parts 144 and 146. (2) Section 3020 of the Resource Conservation and Recovery Act, and (3) the substantive portions of State Water Resources Control Board (SWRCB) Resolution No. 68-16 "Statement of Policy with Respect to Maintaining High Quality of Waters in California".

Section 3020 of the Resource Conservation and Recovery Act (RCRA) prohibits disposal of hazardous waste above or into a formation that contains an underground source of drinking water. This prohibition does not apply to injection of treated contaminated ground water into the same aquifer from which it was withdrawn if (1) such injection is part of a response action under CERCLA, (2) the contaminated ground water is treated to substantially reduce hazardous substances prior to such injection, and (3) the response action will upon completion, be adequate to protect human health and the environment.

The federal Underground Injection Control (UIC) Program requires that injection wells, such as those that would be located at OU-2, do not cause a violation of primary MCLs in the receiving aquifer, and do not adversely affect the health of persons (40 C.F.R. Section 144.12).

Additionally, according to the decision of the EPA Administrator, Resolution 68-16, the water anti-degradation policy, is a state ARAR for the establishment of numerical limits for the reinjection of treated groundwater into clean areas (i.e., high quality waters) of the aquifer, i.e., outside of the contaminated plume. The numerical limits established on a monthly median and on a daily maximum basis to meet the requirements of Resolution 68-16 are set forth in Table 5-C. With respect to the reinjection of treated groundwater within the contaminated plume, treatment shall be at least to the concentration level of the substance being regulated in the groundwater at the point of reinjection measured on a monthly median basis, but not greater than the more stringent of the federal or the state primary MCL, also set forth in Table 5-C. To meet the requirement that the selected remedy be protective of human health and the environment, the Air Force shall maintain hydraulic control of the plume while extracting contaminated groundwater, and reinjecting treated ground water into the contaminant plume or the clean portion of the aquifer.

It is believed that the remedy selected will clean the reinjected water to the selected clean-up standards. Additionally, in response to State concerns regarding the adequacy of current metals data for OU-2, the Air Force has agreed to perform metals and minerals monitoring. If the results necessitate the establishment of reinjection standards for additional constituents in order to meet Resolution 68-16, an amendment to the ROD, inclusion in the Comprehensive Base-wide ROD, or other appropriate procedural mechanism, will be considered by the parties.

#### **Carbon Adsorption**

Use of activated carbon for organics in the liquid-phase treatment (for Alternative IV) and in treatment of the off-gases from the air stripper (for Alternatives II and III) to mitigate potential air emissions, could trigger California Hazardous Waste Control Act (HWCA) (the federally delegated state RCRA program) requirements associated with treatment, storage, regeneration and disposal of the spent carbon, which is regulated as a hazardous waste under HWCA, CCR Title 22. Transportation and storage of hazardous waste for recycling must comply with requirements of HWCA (CCR Title 22). The selected remedy (Alternative II) will utilize off-site thermal regeneration (i.e., recycling) of the spent carbon from the air stripper. The spent carbon will be transported to a thermal regeneration facility by a vendor licensed by the State of California. Since the selected remedy does not contemplate on-site disposal of hazardous or remedial action derived wastes, no such action specific ARARs were selected. Hazardous and remedial action derived wastes could consist of

wastewater, screenings, sludges and other solids generated during construction, operation and maintenance of the treatment system. Off-site disposal of such wastes will be performed in accordance with applicable federal, state and local laws, regulations and ordinances. However, these requirements would not be considered ARARs under CERCLA, as ARARs apply only to on-site activities.

Additionally, carbon adsorption of the off-gasses from the air stripper will mitigate VOC releases to the atmosphere, thereby meeting, inter alia, the requirement of the San Joaquin Valley Unified Air Pollution Control District (Rule 2201) to use best available control technology.

#### Location Specific ARARs

It is known that the Base is in the historical range of several endangered and/or threatened species (Figure 4). In the absence of a finalized study to determine the absence or presence of these species, it will be assumed that they do exist at OU-2. The Endangered Species Act is an ARAR.

Similarly, there is an effort currently underway to determine whether or not jurisdictional wetlands exist at Castle AFB. Preliminary indications are that wetlands do exist at Castle AFB, however, none have been identified in the OU-2 area.

The construction and operation of the OU-2 treatment facility will occur in a manner which will not have an adverse impact on endangered species should they exist. Every reasonable effort will be made to ensure that any resource areas are left in an undisturbed state throughout and following the remedial activities. Should this not be possible, a mitigation plan will be developed in consultation with EPA and the U.S. Fish and Wildlife Service.

#### C. Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk and the adequacy and reliability of controls after implementation of the remedy. The residual risk, or risk remaining after completion of the cleanup, is the same for all of the alternatives, with the exception of the "No Action" Alternative and Alternative I. The treatment standards are the same for all alternatives. The residual risk for TCE at the cleanup standard of 5 ppb is approximately  $1.7E^{-5}$  for showering and  $6.7E^{-7}$  for ingestion. Other VOC contaminants are present, concentrations of which would be reduced to MCLs during the cleanup of TCE to 5 µg/l.

Long-term effectiveness is also measured by the adequacy of controls. Alternatives II through V would have the greatest ability to maintain reliable protection of human health and the environment over time because

active measures are used under these alternatives to control the spread of contamination and to restore the aquifer. All alternatives under consideration include ground water monitoring.

Alternatives II, III, IV, and V provide high degrees of long-term effectiveness and permanence since each treats the ground water to reduce hazardous concentrations of VOCs to drinking water standards. Alternatives II, III, and IV would be effective in treating all of the chemicals of concern listed in Table 2. Chloroform and chloromethane may pose a problem for Alternative V; however, the effectiveness of Alternative V in treating those compounds would be evaluated in the design phase. Some long-term maintenance and ground water monitoring would be required for each alternative until the health-based cleanup standards for ground water have been met, at which point monitoring could be reduced. Alternative I relies solely on institutional controls to prevent exposure. The institutional controls would prevent the installation of new wells and, thereby, the ingestion of contaminated ground water. However, it is questionable whether such controls would be effective with a high degree of certainty for more than 5 to 10 years. Also with Base closure in 1995, the future disposition of the land is questionable.

Alternative I also has long-term ground water monitoring requirements. Monitoring will continue until the health-based cleanup standards (Tables 1 and 2) are met, which would not occur for an estimated 50 years (RI/FS for OU-2, January 1992).

#### D. Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the preference for a remedy that uses treatment to reduce health hazards, contaminant migration, or the quantity of the contaminants at the Site or operable unit. Neither the no-action alternative nor Alternative I use treatment and do not satisfy this criterion; all of the contaminated ground water would remain, although the contaminants in the ground water would potentially attenuate naturally.

Alternatives II, III, IV and V use treatment technologies to reduce the hazard posed by the TCE (and VOC) contaminated ground water. Each alternative treats the chemicals of concern to drinking water standards. Regeneration of the carbon in Alternative II ultimately destroys the TCE. These four alternatives would satisfy the statutory preference for treatment as a principal element.

#### E. Short-Term Effectiveness

Short-term effectiveness refers to the period of time needed to complete the remedy and to prevent adverse impacts on human health and the environment that may be posed during construction and implementation of the remedy. Since a complete health and safety plan would be completed prior to the implementation of the

remedies, short-term adverse impacts during construction of the remedies would be minimized. Alternatives II through V are all estimated to reduce in situ ground water contamination to MCL levels in 16 years.

The no-action alternative and Alternative I present the greatest risk to the community and the environment since further migration of the plume is not prevented. Therefore, a greater area would be impacted by the contamination.

#### F. Implementability

Implementability refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the selected remedy. It also includes coordination of Federal, State and local governments in cleanup of the Site or operable unit.

The no-action alternative and Alternative I would be the easiest to implement since monitoring wells have been installed and are periodically monitored at OU-2.

Alternatives II and IV would be the next easiest to implement since both use proven technologies that are readily obtained and can be constructed in the area of OU-2. If additional contaminants are found at OU-2, the components of either alternative can be sized to include the additional requirements.

Alternatives III and V are somewhat more difficult to implement. Alternative III uses some non-routine and specialized materials and equipment and specialized operator training is required. Alternative V uses proven technologies that are readily obtained and constructed in the area of OU-2; however, non-routine and specialized operator training may be required. The operator training required for Alternatives III and V is more specialized than that required for Alternatives II and IV. Alternative III requires the use of high-pressure steam and Alternative V requires specific doses of chemicals as compared to primarily mechanical systems for Alternatives II and IV.



## G. Cost

This criterion examines the estimated costs for each remedial alternative. For comparison, capital costs and annual O&M costs are used to calculate a total net present worth cost for each alternative. The no-action alternative is not discussed in detail in this section because it requires no action and therefore no costs other than costs for monitoring existing wells.

Individual cost estimates for each of the alternatives are also the result of an accumulation of vendor information and engineering judgment. The costs assume that 6 aquifer volumes would be treated over 16 years. The costs assume a materials discount rate of six percent. Costs developed here are for comparison purposes only. Actual costs developed after further study and design may be substantially different; however, the relative relationship of the costs will remain the same. With the exception of the "No Action" Alternative and Alternative I, the least expensive treatment alternative is Alternative II with a present worth cost of \$3,200,000, while the most costly is Alternative III, at \$9,300,000 (Table 4).

## H. State Acceptance

State acceptance indicates whether, based on a State's review of the RI/FS and Proposed Plan, the State agrees with the preferred alternative.

The parties to the FFA for Castle AFB (i.e., US EPA, Cal-EPA's DTSC, and the US Air Force) have all been involved in the selection of the remedy. Based on the present database, the State agrees in concept with the selected remedy for OU-2.

Also, the State supports injection of the treated effluent, but is concerned when injection takes place directly back into the plume. The injection increases the likelihood that the hydraulic control of the plume will not be achieved and that spreading of the contaminant will occur. This will be fully addressed in the remedial design phase.

The State has also requested that this ROD commit the Air Force to undertake additional characterization, as necessary, for the design of the remedial system, including the extraction and injection wells. This additional investigative effort will include further characterization of the extent of contamination to more carefully determine the plume boundaries and water quality characteristics. This effort shall also include additional monitoring wells both on and off the Base. The design of the remedy will consider a phased implementation of the treatment system. The overall project schedule will balance investigation and remediation priorities to assist the Air Force in expediting reuse of the OU-2 part of the closing Air Force Base. EPA and the State will work with the Air Force to streamline the technical and administrative requirements to enable the development of an expeditious overall project schedule.

## I. Community Acceptance

The Air Force has solicited input from the community on the alternatives evaluated for OU-2. No commentor expressed disagreement with the preferred alternative. A response to these comments is provided in Attachment B.

## IX. SELECTED REMEDY

Five alternative remedial actions (and the no-action alternative) were investigated in detail for the treatment of the contaminated ground water at OU-2.

No-Action Alternative

Alternative I - Institutional Controls

Alternative II - Packed Tower Air Stripping

Alternative III - Steam Stripping

Alternative IV - Carbon Adsorption

Alternative V - Catalyzed Chemical Oxidation

Based on the evaluation of the six alternatives and consideration of the nine criteria, Alternative II is selected. This selection is based on operability, degree of treatment, handling of treatment residues, and expected costs. The selected remedy requires additional OU-2 plume definition, water quality characterization of the plume and the potential receiving water of the treatment system effluent, and hydrological aquifer characterization. The Air Force has developed a detailed scope of work for completion of characterization of all aquifers. The scope of work will be the basis for the time schedule. Based on further data collection, phased implementation of the design will be considered.

Alternative III will be difficult to implement since there may not be a steam supply that is readily available and specialized operator training is required. The expected cost also makes this alternative prohibitive.

Although Alternative IV can provide a higher degree of removal of TCE from ground water, the spent carbon must either be regenerated or handled and disposed of as hazardous waste. Furthermore, activated carbon has a finite life and requires close monitoring to determine when replacement is required. Unlike the stripping tower, the performance of the activated carbon will be affected by other dissolved contaminants, and the adsorption capacity may not perform consistently over the life of the carbon as adsorption sites become occupied by contaminant molecules.

While the technologies used in Alternative V are readily available, specialized operator training may be required. The performance of the chemical oxidation treatment system will be affected by other undefined

contamination that may be present at OU-2. An assumption made in the development and screening of the alternatives is that the primary chemical of concern is TCE. Although other volatile organic compounds have been detected in OU-2, TCE is considered to be the most prevalent and mobile of the contaminants. The currently operating removal action in the DA-4 and Wallace Road areas will be considered during the preparation of the OU-2 remedial design.

#### Ground Water Extraction and Treatment System

Ground water will be extracted using multiple extraction wells. Four extraction wells are currently in place as part of the Castle AFB's ongoing removal action. The exact location, number and pumping rates of any additional remedial action extraction wells, as well as a decision on the long-term use of the current removal action extraction wells, will be addressed during the design of the remedial ground water recovery system. Recovered ground water will be treated on-site using an air stripper system with activated carbon treatment of the off-gases. Additional monitoring wells are needed to verify and further define the OU-2 contaminant plume. Final flow rates and treatment unit dimensions will be determined during the remedial design. The treated effluent will be injected back into the subsurface through injection wells constructed as part of the remedial action.

Moreover, the selected remedy (1) does not contemplate discharge to surface waters, and such discharge is prohibited, and (2) prohibits the bypass or overflow of untreated or partially treated waste. The Remedial Design and the Remedial Action Work Plan will provide for alternative discharge options in the event the reinjection capacity becomes insufficient to handle the treated effluent. These alternative discharge options will be used only on a temporary basis.

#### Cleanup Standards for Ground Water

The aquifer cleanup standards (MCLs) are set forth in Tables 5-A and 5-B. The selected remedy, when complete, will have reduced the concentrations of contaminants in ground water to the cleanup standards, thereby satisfying the chemical-specific ARARs for aquifer cleanup (Federal or State MCLs, whichever is more stringent). In addition, during remediation, this remedy will meet chemical and action-specific ARARs, as presented in Tables 5-A, 5-B, and 5-C for discharging the treated water into the aquifer by injection.

#### Ground Water Remedy Implementation

The detailed implementation of the selected remedial action will be performed by the Air Force in consultation with the regulatory agencies during the RD/RA phase, at which time the Air Force will develop

reporting, notification and monitoring programs. The monitoring program shall include sufficient monitoring (both in terms of frequency and test methods employed) to evaluate the effectiveness of the remedial action and ensure that the effluent reinjection standards adopted herein are being met. The Air Force shall, at a minimum, include the following in the RD/RA phase: Locations of the extraction, injection and performance monitoring wells, estimated extraction and injection rates, proposed operational procedures, proposed contingency plan for the extraction, treatment and injection system in the event of power outage and/or mechanical failure, geologic well logs and well development data sheets for all available extraction, injection and performance monitoring wells proposed for the OU-2 groundwater treatment system. The operational procedures shall reflect that the groundwater treatment system will not be operated in excess of its design capacity without the prior approval of the regulatory agencies.

Phased implementation of the remedy may be necessary to assure adequate evaluation and placement of extraction and injection wells. An operation and maintenance plan for the ground water extraction and treatment system will be carefully monitored on a regular basis and the system may be modified (including the installation of additional monitoring wells) as warranted by the performance data collected during its operation upon agreement of the parties to the Federal Facility Agreement.

## X. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment as required by Section 121 of CERCLA. The selected remedial action, when complete, will comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental facility siting laws. The selected remedy is cost-effective, uses permanent treatment technologies to the maximum extent practicable and includes treatment as a principal element. The following sections discuss how the selected remedy for OU-2 meets the statutory requirements.

### Protection of Public Health and the Environment

Attainment of clean-up standards will assure that the levels of the chemicals of concern in the ground water at OU-2 will not exceed drinking water standards. Alternative II uses engineering controls in the form of a ground water extraction treatment system to remove contaminated ground water from the aquifer. The extraction of contaminated ground water will significantly reduce the threat of exposure to residents. The implementation of this remedy will not create any short-term risks nor any negative cross-media impacts.

### Attainment of ARARs

All ARARs will be met by the selected remedy. The remedy will achieve compliance with chemical-specific ARARs by treating ground water to concentrations at or below the chemical-specific cleanup standards. Action-specific ARARs will be met for the injection of ground water. RCRA requirements will be met for the treatment facility, and storage and handling of spent carbon. Air emission control requirements will be satisfied by use of activated carbon.

### Cost Effectiveness

EPA, the Air Force and the State of California believe that the selected remedy fulfills the nine criteria of the NCP and provides overall effectiveness in relation to its cost. Alternative II has a capital cost of approximately \$340,000 and an approximate annual O&M cost of \$290,000. The total net present value is \$3,200,000, based on a 16-year estimate for the time required to clean up OU-2.

### Use of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner for the Site or operable unit. Of those alternatives that are protective of human health and the environment (and comply with ARARs), EPA, the Air Force, and the State of California have determined that the selected remedy provides the best balance of long-term effectiveness and permanence; reduction of toxicity, mobility and volume through treatment; short-term effectiveness; implementability and cost-effectiveness.

### Preference for Treatment as a Principal Element

Chemicals of concern in the ground water will be extracted and treated. The treatment will occur in the capture of the VOCs by the activated carbon treatment of the off-gasses from the air stripper. Captured contaminants will be destroyed when the carbon is regenerated for recycling or disposed of in a permitted hazardous waste landfill. Therefore, this remedy satisfies the statutory preference for remedies that employ treatment which permanently and significantly reduces toxicity, mobility or volume of hazardous substances as a principal element.

Table 4. SUMMARY OF COMPARATIVE ANALYSIS

Criteria	No-action Alternative	Alternative I Institutional Controls	Alternative II Air Stripping	Alternative III Steam Stripping	Alternative IV Carbon Adsorption	Alternative V Catalyzed Chemical Oxidation
OVERALL PROTECTIVENESS						
Human health protection						
- Ground water exposure for existing users	No reduction in risk.	No reduction in risk.	Aquifer pumping will control areal extent of contaminant plume.	Aquifer pumping will control areal extent of contaminant plume.	Aquifer pumping will control areal extent of contaminant plume.	Aquifer pumping will control areal extent of contaminant plume.
- Ground water exposure for future users	Likely increase in risk due to plume migration.	Possible increase in risk due to plume migration.	Aquifer pumping will reduce contaminant levels and contain plume.	Aquifer pumping will reduce contaminant levels and contain plume.	Aquifer pumping will reduce contaminant levels and contain plume.	Aquifer pumping will reduce contaminant levels and contain plume.
Environmental protection	Allows continued migration of contaminant plume.	Allows continued migration of contaminant plume.	Continued plume migration is mitigated by extraction. Treatment will reduce contaminant levels below drinking water standards. Atmospheric VOC emission levels will be controlled through use of carbon.	Continued plume migration is mitigated by extraction. Treatment will reduce contaminant levels below drinking water standards. Atmospheric VOC emission levels will be controlled through use of carbon.	Continued plume migration is mitigated by extraction. Treatment will reduce contaminant levels below drinking water standards. No atmospheric VOC emission levels.	Continued plume migration is mitigated by extraction. Treatment will reduce contaminant levels below drinking water standards. No atmospheric VOC emission levels.

Table 4. SUMMARY OF COMPARATIVE ANALYSIS

Criteria	No-action Alternative	Alternative I Institutional Controls	Alternative II Air Stripping	Alternative III Steam Stripping	Alternative IV Carbon Adsorption	Alternative V Catalyzed Chemical Oxidation
COMPLIANCE WITH ARARS						
Chemical-specific ARARS	Will not meet cleanup standards for aquifer or drinking water.	Will not meet cleanup standards for aquifer or drinking water.	Will meet cleanup standards.	Will meet cleanup standards.	Will meet cleanup standards.	Will meet cleanup standards.
Location-specific ARARS	Will meet location-specific ARARS.	Will meet location-specific ARARS.	Will meet location-specific ARARS.	Will meet location-specific ARARS.	Will meet location-specific ARARS.	Will meet location-specific ARARS.
Action-specific ARARS	No action-specific ARARS.	Would not meet any ARARS since there will be no action.	Would meet air release standards from air strippers and injection requirements. Would meet RCRA requirements	Would meet air release standards and injection requirements. Would meet RCRA requirements	Would meet injection requirements. Air release not applicable. Would meet RCRA requirements	Would meet injection requirements. Air release not applicable.
LONG-TERM EFFECTIVENESS AND PERMANENCE						
Magnitude of residual risk						
- Ground water exposure for existing users	Likely increase in risk due to plume movement.	Possible increase in risk due to plume movement.	Treatment will reduce contaminant levels to below drinking water standards.	Treatment will reduce contaminant levels to below drinking water standards.	Treatment will reduce contaminant levels to below drinking water standards.	Treatment will reduce contaminant levels to below drinking water standards.
- Ground water exposure for future users	Likely increase in risk due to plume movement.	Possible increase in risk due to plume movement.	Aquifer pumping will reduce contaminant levels and contain plume.	Aquifer pumping will reduce contaminant levels and contain plume.	Aquifer pumping will reduce contaminant levels and contain plume.	Aquifer pumping will reduce contaminant levels and contain plume.
Adequacy and reliability of controls	No controls over remaining contamination. No reliability.	No controls over remaining contamination. No reliability.	Aquifer pumping and air stripping offer high reliability of controlling contamination.	Aquifer pumping and steam stripping offer high reliability of controlling contamination.	Aquifer pumping and carbon adsorption offer high reliability of controlling contamination.	Aquifer pumping and chemical oxidation offer high reliability of controlling contamination.

Table 4. SUMMARY OF COMPARATIVE ANALYSIS

Criteria	No-action Alternative	Alternative I Institutional Controls	Alternative II Air Stripping	Alternative III Steam Stripping	Alternative IV Carbon Adsorption	Alternative V Catalyzed Chemical Oxidation
Need for 5-year review	Review would be required to determine migration of the plume.	Review would be required to ensure adequate exposure prevention measures are being maintained.	Review would be required to determine degree of mitigation and amount of contamination remaining in aquifer.	Review would be required to determine degree of mitigation and amount of contamination remaining in aquifer.	Review would be required to determine degree of mitigation and amount of contamination remaining in aquifer.	Review would be required to determine degree of mitigation and amount of contamination remaining in aquifer.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT						
Treatment process used	None.	None.	Aquifer pumping, air stripping in packed tower, and carbon air emission control.	Aquifer pumping, steam stripping, and carbon air emission control.	Aquifer pumping and adsorption in 2 carbon adsorption vessels in series.	Aquifer pumping and UV/hydrogen peroxide chemical oxidation.
Amount destroyed or treated	None.	None.	99% of the VOCs are removed.	99% of the VOCs are removed.	Nearly 100% of the VOCs are removed from ground water.	99% of the VOCs are removed.
Reduction of toxicity, mobility, or volume through treatment	None.	None.	Reduction of toxicity of contaminant in ground water through treatment. Reduction of mobility and volume through aquifer pumping.	Reduction of toxicity of contaminant in ground water through treatment. Reduction of mobility and volume through aquifer pumping.	Reduction of toxicity of contaminant in ground water through treatment. Reduction of mobility and volume through aquifer pumping.	Reduction of toxicity of contaminant in ground water through treatment. Reduction of mobility and volume through aquifer pumping.
Irreversible treatment	None.	None.	Irreversible.	Irreversible.	Reversible.	Reversible.



Table 4. SUMMARY OF COMPARATIVE ANALYSIS

Criteria	No-action Alternative	Alternative I Institutional Controls	Alternative II Air Stripping	Alternative III Steam Stripping	Alternative IV Carbon Adsorption	Alternative V Catalyzed Chemical Oxidation
Type and quantity of residual remaining after treatment	Not applicable.	Not applicable.	Saturated carbon adsorption cartridges will require regeneration or disposal as hazardous waste.	Saturated carbon adsorption cartridges will require regeneration or disposal as hazardous waste. Concentrated VOC/water mixture will require disposal as hazardous waste or recycling.	Saturated carbon adsorption cartridges will require regeneration or disposal as hazardous waste.	None.
Statutory preference for treatment	Does not satisfy.	Does not satisfy.	Satisfies.	Satisfies.	Satisfies.	Satisfies.
SHORT-TERM EFFECTIVENESS						
Community protection	Plume likely to spread and more wells would be impacted.	Plume likely to spread and more wells would be impacted.	No additional risk to community in short term.	No additional risk to community in short term.	No additional risk to community in short term.	No additional risk to community in short term.
Worker protection	Not applicable.	Risk to workers during sampling only.	Protection required against exposure to contaminated ground water.	Protection required against exposure to contaminated ground water and steam.	Protection required against exposure to contaminated ground water.	Protection required against exposure to contaminated ground water and oxidizing agents.
Environmental impacts	Continued impact from existing conditions. Plume likely to spread.	Continued impact from existing conditions. Plume likely to spread.	Areal extent and contaminant levels in plume expected to decrease. Atmospheric emission levels at allowable levels.	Areal extent and contaminant levels in plume expected to decrease. Atmospheric emission levels at allowable levels.	Areal extent and contaminant levels in plume expected to decrease. No atmospheric impact.	Areal extent and contaminant levels in plume expected to decrease. No atmospheric impact.

Table 4. SUMMARY OF COMPARATIVE ANALYSIS

Criteria	No-action Alternative	Alternative I Institutional Controls	Alternative II Air Stripping	Alternative III Steam Stripping	Alternative IV Carbon Adsorption	Alternative V Catalyzed Chemical Oxidation
Time until action is complete	Not applicable.	50 years.	16 years.	16 years.	16 years.	16 years.
IMPLEMENTABILITY						
Ability to construct and operate	Not applicable.	Not applicable.	Construction is very feasible. Operation is expected to require continuing monitoring and adjustment.	Construction is very feasible. Operation is expected to require continuing monitoring and adjustment.	Construction is very feasible. Operation will require continuing monitoring and carbon regeneration.	Construction is very feasible. Operation is expected to require continuing monitoring and adjustment.
Ease of doing more action if needed	On-going monitoring may require action and/or another RI/FS.	On-going monitoring may require action and/or another RI/FS.	Treatment plant capacity limits additional action.	Treatment plant capacity limits additional action.	Treatment plant capacity limits additional action.	Treatment plant capacity limits additional action.
Ability to monitor effectiveness	Not applicable.	On-going monitoring program on quarterly basis is expected to detect plume movement.	Effluent monitoring is very feasible.	Effluent monitoring is very feasible.	Effluent monitoring is very feasible.	Effluent monitoring is very feasible.
Ability to obtain approvals and coordinate with other agencies	Not applicable.	No approval necessary.	Need to coordinate with air board for air emissions and RWQCB to inject effluent.	Need to coordinate with air board for air emissions and RWQCB to inject effluent.	Need to coordinate with RWQCB to inject effluent.	Need to coordinate with RWQCB to inject effluent.
Availability of services and capacities	Not applicable.	Sampling and analytical services available. No other services required.	Carbon from air emission control replacement/regeneration service is required.	Carbon from air emission control replacement/regeneration service is required; recycling service is required.	Carbon from air emission control replacement/regeneration service is required.	Continuous supply of chemicals and UV bulbs are required.

Table 4. SUMMARY OF COMPARATIVE ANALYSIS

Criteria	No-action Alternative	Alternative I Institutional Controls	Alternative II Air Stripping	Alternative III Steam Stripping	Alternative IV Carbon Adsorption	Alternative V Catalyzed Chemical Oxidation
Availability of equipment, specialists, and materials	Not applicable.	None required.	Requires readily available equipment and materials. Specialists are readily available and trained.	Requires non-routine and some specialized equipment and materials. Non-routine and specialized operator training is required.	Requires readily available equipment and materials. Specialists are readily available and trained.	Requires readily available equipment and materials. Non-routine and specialized training may be required.
Availability of technologies	None required.	None required.	Air stripping technology readily available.	Steam stripping technology readily available.	Carbon adsorption technology readily available.	Chemical oxidation technology readily available.
COST						
Capital cost	Not applicable.	\$0	\$ 340,000	\$ 1,400,000	\$ 500,000	\$ 500,000
Annual O&M cost	Not applicable.	\$ 30,000	\$ 290,000	\$ 780,000	\$ 700,000	\$ 340,000
Life Cycle cost <sup>a</sup>	Not applicable.	\$500,000	\$3,200,000	\$9,300,000 <sup>b</sup>	\$7,900,000	\$4,000,000
a. Assumes 6 flushings of the aquifer over 16 years and a discount rate of 6%. b. No capital costs for steam generation are assumed; however, there are O&M costs.						

Table 5-A  
APPLICABLE OR RELEVANT AND APPROPRIATE FEDERAL REQUIREMENTS FOR OU-2

Source	Standard, Requirement, Criterion or Limitation	Description of Standard	Applicable or Relevant and Appropriate	Application to Selected Alternative
Chemical Specific Safe Drinking Water Act, 42 U.S.C. § 300 et seq.; National Primary Drinking Water Regulations, 40 C.F.R. Part 141	40 C.F.R. §§ 141.11 - .12	Establishes health based standards (maximum contaminant levels (MCLs)) for public water systems; relevant and appropriate for groundwater that may become a drinking water source.	Relevant and Appropriate	The federal MCL for aquifer clean-up is 5 ppb for TCE and 5 ppb for PCE. The State of California MCL has been selected as the aquifer clean-up level for benzene; the State MCL is 1 ppb. See Table 5-B.  The numerical limits set for reinjection of treated groundwater into the contaminated plume are also based on the more stringent of federal or state MCLs, and are set forth on Table 5-C.
Location Specific Endangered Species Act, 16 U.S.C. § 1531 et seq., 50 C.F.R. Parts 200, 402	EPA, Section 7; 50 C.F.R. Part 402.	Requires action to conserve endangered species and critical habitats upon which they depend. Includes consultation requirement with the Department of Interior.	Applicable.	CAFB is in the historical range of several endangered species (San Joaquin Valley Kit Fox, Elderberry Longhorn Beetle and Fresno Kangaroo Rat). (refer to table 3-A) CAFB will comply with DOI consultation requirements.
Action Specific California Hazardous Waste Control Act ("HWCA"), H&S Code § 25100 et seq.; Health and Safety Standards for Management of Hazardous Waste, CCR Title 22	CCR, Title 22, Div. 4.5, Ch. 14, Art. 9, §§ 66264.170-.178  NOTE: The federal RCRA program was delegated to the State of California on August 1, 1992. Compliance with the delegated program under State law is a federal ARAR and is deemed to be compliance with RCRA.	Applies to owners and operators who store hazardous waste for more than 90 days in containers. Covers use and management of containers, containment, inspections and closure.	Relevant and Appropriate.	The spent granular activated carbon units are considered to be containers. The container requirements must be met if the spent GAC units are stored on-site for more than 90 days.

Table 5-A  
APPLICABLE OR RELEVANT AND APPROPRIATE FEDERAL REQUIREMENTS FOR OU-2

Source	Standard, Requirement, Criterion or Limitation	Description of Standard	Applicable or Relevant and Appropriate	Application to Selected Alternative
<p>Action Specific California Hazardous Waste Control Act ("HWCA"), H&amp;S Code § 25100 et seq.; Health and Safety Standards for Management of Hazardous Waste, CCR Title 22</p>	<p>CCR, Title 22, Div. 4.5, Ch. 14, Art. 9, §§ 66264.600-.603</p> <p>NOTE: The federal RCRA program was delegated to the State of California on August 1, 1992. Compliance with the delegated program under State law is a federal ARAR and is deemed to be compliance with RCRA.</p>	<p>Applies to owners and operators who treat, store or dispose of RCRA hazardous waste in miscellaneous units. Miscellaneous units must be located, designed, constructed, operated maintained and closed in accordance with these requirements.</p>	<p>Relevant and Appropriate.</p>	<p>The selected remedy will utilize air stripper units, which are considered to be miscellaneous units.</p>
<p>Action Specific U.S. EPA Guidance on the Control of Air Emissions from Air Strippers at Superfund Groundwater Sites, OSWER Directive 9355.0-28</p>	<p>U.S. EPA Guidance on the Control of Air Emissions from Air Strippers at Superfund Groundwater Sites, OSWER Directive 9355.0-28</p>	<p>Policy sets target levels for air emissions from Superfund remedial actions where ARARs do not exist. Total VOCs are established at 15 lbs. per day.</p>	<p>To be considered adopted as a performance standard if more stringent than San Joaquin Valley Unified Air Pollution Control District's emissions limits.</p>	<p>Will apply to emissions limits from air stripper if more stringent than substantive requirements of San Joaquin Valley Unified Air Pollution Control District.</p>
<p>Action and Location Specific Safe Drinking Water Act, 42 U.S.C. § 300h et seq.; Underground Injection Control Regulations, 40 C.F.R. Parts 144 and 146; Resource Conservation and Recovery Act, § 3020</p>	<p>40 C.F.R. Parts 144 and 146, RCRA § 3020</p>	<p>The UIC regulations prohibit activities that allow movement of contaminants into underground sources of drinking water which may result in violation of MCLs or adversely affect health. Class IV wells are banned except for injection of treated groundwater into the same formation from which it was withdrawn as part of a CERCLA clean-up (RCRA § 3020).</p>	<p>Applicable.</p>	<p>Applicability of UIC regulations will be dependent on the selection and design of the reinjection wells.</p>

Table 5-8  
APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR OU-2

Source	Standard, Requirement, Criterion or Limitation	Description of Standard	Applicable or Relevant and Appropriate	Application to Selected Alternative
Chemical Specific California Safe Drinking Water Act, H&S Code, Div. 5, Part 1, Ch. 7, §§ 4010, 4023.1, .3, 4024, 4025, 4026.4	CCR, Title 22, Div. 4, Ch. 15, Article 4, Article 5, Article 8 (§ 64444.5)	Establishes health based standards (maximum contaminant levels) for public water systems; relevant and appropriate for groundwater that may become a drinking water source.	Relevant and Appropriate	The State MCL for aquifer clean-up is 1 ppb for benzene. Standards for TCE and PCE are each established at 5 ppb under the federal Safe Drinking Water Act. See Table 5-A.  The numerical limits set for reinjection of treated groundwater into the contaminated plume are also based on the more stringent of the federal or State MCLs, and are set forth on Table 5-C.
Chemical Specific Porter-Cologne Water Quality Control Act, (California Water Code Sections 13140, 13240, 13263; Water Quality Control Plan ("Basin Plan") for the Central Valley Regional Water Quality Control Board	State Water Resources Control Board Resolution No. 68-16 ("Antidegradation Policy")	Promulgated rule setting forth the State Board's policy on maintaining the high quality of California's waters. Standard is narrative.	Applicable	Specific effluent treatment standards to implement the narrative standards set forth in the resolution are set forth in Table 5-C. These standards apply only to reinjection into clean areas (i.e., high quality waters) of the aquifer.
Porter Cologne Water Quality Control Act (California Water Code Sections 13140, 13240); Water Quality Control Plan ("Basin Plan") for the Central Valley Regional Water Quality Control Board	State Water Resources Control Board Resolution NO. 88-63 ("Sources of Drinking Water Policy")	Defines all ground and surface waters as existing or potential sources of drinking water unless total dissolved solids are greater than 3000 ppm, well yield is less than 200 gpd from a single well or ground water is unreasonable to treat using best management practices or best economically achievable treatment practices.	Applicable	The identification of the OU-2 aquifer as a potential drinking water source forms the basis for the selection of MCLs and Resolution 68-16 as chemical specific ARARs.

Table 5-B  
APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR OU-2

Source	Standard, Requirement, Criterion or Limitation	Description of Standard	Applicable or Relevant and Appropriate	Application to Selected Alternative
Action Specific Mulford-Carrell Air Resources Act, H&S Code § 39000 et seq.; CCR Title 17, Part III, Chapter 1, § 60000	San Joaquin Valley Unified Air Pollution Control District ("APCD") Rule 2201 § 4.1  NOTE: To the extent that this rule was adopted under the SIP, it would be a federal ARAR pursuant to the federal Clean Air Act, 42 U.S.C. § 7401 et seq.	The Act authorizes the APCD to set allowable emissions limits. This rule, entitled "New and Modified Stationary Source Review Rule" requires that best available control technology ("BACT") be used to treat off-gasses.	Applicable	The carbon treatment units to be used in the selected remedial action are considered BACT by the APCD. Specific emissions limits to comply with this rule will be established.  NOTE: The APCD performs a screening health risk assessment for groundwater clean-up projects based on the CAPCOA Risk Assessment Guideline.
Porter-Cologne Water Quality Control Act, California Water Code Section 13164, 13170, 13240, 13241	Table II-2 of the Water Quality Control Plan ("Basin Plan") for the Central Valley Water Quality Control Board	This table, entitled "Ground Water Bodies and their Beneficial Uses" lists 40 ground water bodies and the beneficial uses assigned to them.	Applicable	The ground water body named "San Joaquin Basin" is identified as having the following beneficial uses: municipal, and domestic, irrigation and stock watering.
Porter-Cologne Water Quality Control Act, California Water Code Section 13164, 13170, 13240, 13241	Page V-1 of the Water Quality Control Plan ("Basin Plan") for the Central Valley Water Quality Control Board	Describes the Regional Board's surveillance and monitoring program for water quality data.	Applicable	Provides the basis for development of the ground water monitoring program that will take place during the RD/RA phase.
Mulford-Carrell Air Resources Act, H&S Code § 39000 et seq.; CCR Title 17, Part III, Chapter 1, § 60000	San Joaquin Valley Unified Air Pollution Control District ("APCD") Rule 2201 § 4.2.1.4	The Act authorizes the APCD to set allowable emissions limits. This rule, entitled "New and Modified Stationary Source Review Rule" provides that emissions offsets are not required for increases in permitted emissions of VOCs of less than ten tons/year.	Applicable	Emissions offsets for VOCs will be required only if annual emissions from the air stripper exceed 10 tons/year.

Table 5-C  
GROUND WATER DISCHARGE TREATMENT STANDARDS

Table 5-C GROUND WATER DISCHARGE TREATMENT STANDARDS			
Constituent	Standards for Injection into Non-Contaminated Portions of the Aquifer Based on State Board Resolution 68-16 (Concentrations in µg/l)		Standards for Injection in the Contaminated Portions of the Aquifer Based on the more stringent of (a) MCLs (State or Federal whichever is more stringent) as a Daily Maximum (see below) or (b) In Situ Groundwater Concentrations at the Point of Injection as 30-Day Median (Concentrations in µg/l)
	30-Day Median	Daily Maximum	(a) State or Federal MCLs Daily Maximum
Chlorobenzene	0.5	-	--
Chloromethane <sup>2</sup>	0.5	-	--
Chloroform <sup>2</sup>	0.5	-	--
1,2-Dichloroethylene (cis)	0.5	-	--
Tetrachloroethylene (PCE) <sup>2</sup>	0.5	-	5
Trichloroethylene (TCE) <sup>2</sup>	0.5	-	5
Total Volatile Organic Constituents (VOCs) <sup>3</sup>	1.0	5.0	--
Benzene <sup>2</sup>	0.5	1.0	1
Ethylbenzene	0.5	-	--
Toluene	0.5	-	--
Xylene	0.5	-	--
pH	6.5 < pH > 8.5		
Nitrates	10 ppm as Nitrogen, or background of the receiving water, whichever is greater.		

<sup>1</sup> EPA Method 601 and 602 with a detection limit of 0.5 µg/l or less. If the Daily Maximum is exceeded, an additional sample(s) must be collected and analyzed within the same month to demonstrate that the monthly median has not been exceeded.

<sup>2</sup> Carcinogens.

<sup>3</sup> Total VOCs will be the sum of all EPA Method 601 and 602 analysis constituents, including TCE.



Table 6.  
RESULTS OF QUARTERLY GROUND WATER SAMPLING PROGRAM SUMMARY OF TCE CONCENTRATIONS AT OU-2  
µg/l

Sampling point	1st round (7/89)	2nd round (10/89)	3rd round (3/90)	4th round (6/90)	5th round (12/90-1/91)	6th round (4-5/91)
440	1.3	3	10.4	10.4	ND	--
455	1.2	1.1	0.8	1.6	0.8	--
501	570	20	3.900	5.600	Dry	--
502	370	780	716	850	770	--
503	ND	10.3	ND	ND	ND	--
504	ND	ND	ND	ND	ND	--
505	0.8	ND	10.4	ND	ND	--
506	3.6	3.6	6	4.4	2	--
507	2.4	3.8	4.4	3.8	10.5	--
508	33	88	100	58	76	120
509	0.9	0.8	2.2	2.2	2.5	--
510	25	39	40	61	91	92
511	2.6	ND	3	5.9	3.7	--
512	16	25	32	35	32.6	45
513	ND	0.8	0.8	10.3	ND	--
514	3.1	3	3.5	3.5	2	--
515	2.3	4.8	0.7	ND	ND	--
516	49	76	71	59	76	--
576A	--	--	--	--	9.1	17
601	ND	0.7	ND	ND	ND	--
602	ND	1.2	ND	ND	ND	--
604	ND	ND	ND	ND	ND	--
701	ND	ND	ND	ND	ND	--
702	ND	ND	ND	ND	ND	--
702A	--	--	--	0.6	ND	6.5
703	ND	ND	0.5	ND	ND	--
704	19	22	100	77	92	120
MID 70	ND	ND	--	--	--	--
D5144	270	--	--	--	--	--
D5161	Pump removed	Pump removed	--	--	--	--
D5266	220	240	--	--	--	--

Table 6.  
RESULTS OF QUARTERLY GROUND WATER SAMPLING PROGRAM SUMMARY OF TCE CONCENTRATIONS AT OU-2  
μg/l

Sampling point	1st round (7/89)	2nd round (10/89)	3rd round (3/90)	4th round (6/90)	5th round (12/90-1/91)	6th round (4-5/91)
I5266	4.7	6.5	--	--	--	--
D5482	ND	ND	--	--	--	--
D5486	1.4	5	--	--	--	--
D5502	ND	ND	--	--	--	--
D5682	Dry	ND	--	--	--	--
ND: Not detected. J: Estimated value. --: Not sampled.						

Table 7  
TCE RESULTS OF PRIVATE WELLS IN WALLACE ROAD AREA

Sampling point	Date of collection	Laboratory	TCE, $\mu\text{g/l}$
5144 Wallace Road. old well (domestic)	1984 January 30	USAF	ND
	1985 January 24 April 24 June 19 July 8 August 6 September 10 October 3 December 9	USAF USAF USAF USAF USAF USAF USAF USAF	ND ND 1.7 2.7 3.8 2.8 11 0.9
	1986 January 10 February 4 April 2 May 20 June 20	USAF USAF NA NA NA	2.1 1.4 ND 2.6 3.4
(connected to base water)	1989		
5144 Wallace Road. new well (domestic)	1986 April 2 May 20 June 20 July 15 August 12 September 2 October 7 November 17 December 2	NA NA NA NA NA CWL CWL NA NA	20 18.1 30 56.5 43.6 94.6 61.8 61.4 59.1
	1987 January 12 July 14 September 18	NA CWL APPL	41.1 87.3 96
(connected to base water)	1989		
5161 Wallace Road	1985 December 9	USAF	ND
	1986 January 10 February 4 April 2 May 20 June 20 July 15 August 12 September 2 October 7 November 17 December 2	USAF USAF NA CWL NA NA CWL CWL CWL NA NA	5.3 4.3 9.4 7.8 6.3 11.6 15.3 41.1 28.1 28.5 44.2
	1987 January 2 July 14	NA CWL	33.4 57.2
(connected to base water)	1989		
5266 Wallace Road (domestic)	1985 December 9	USAF	ND

Table 7.  
TCE RESULTS OF PRIVATE WELLS IN WALLACE ROAD AREA

Sampling point	Date of collection	Laboratory	TCE, $\mu\text{g/l}$
	1986 January 10 February 4 April 2 May 20 June 20 July 15 August 12 September 2 October 7 November 17 December 9	USAF USAF NA NA NA NA CWL CWL CWL NA NA	ND ND ND 0.27 0.5 0.9 1.3 3.5 1.8 7.7 6.5
	1987 January 12 February 10 March 10 April 13 July 14 September 18	NA NA NA NA CWL APPL	6.5 8.5 12.9 11.2 20.3 20
(connected to base water)	1989		
5486 Wallace Road (domestic)	1985 December 9	USAF	ND
5486 Wallace Road (cont.)	1986 January 10 February 4 April 2 May 20 June 20 July 15 August 12 September 2 October 7 November 17 December 2	USAF USAF NA NA NA ND CWL CWL CWL NA NA	ND ND ND <0.12 0.15 ND ND ND ND ND ND
	1987 January 12 February 10 March 10 April 13	NA NA NA NA	ND ND ND ND
(GAC filter installed, sample taken before filter)	1990 January February March April May June July August September October November December	BSK BSK BSK BSK BSK BSK BSK BSK BSK BSK BSK BSK	ND ND 3.9 ND 2.5 3/9 9.9 35 ND ND 55 41
	1991 January February March April May June July August September October November December	BSK BSK BSK BSK BSK BSK BSK BSK BSK BSK BSK BSK	56 53 36 38 46 43 65 69 27 70 87 120

Table 7.  
TCE RESULTS OF PRIVATE WELLS IN WALLACE ROAD AREA

Sampling point	Date of collection	Laboratory	TCE, $\mu\text{g/l}$
5486 Wallace Road (cont.)	1992		
	January	BSK	70
	February	BSK	87
	March	BSK	120
	April	BSK	210
	May	BSK	87
	June	BSK	66.5
	July	BSK	77
	August	BSK	67
	September	BSK	88
	October	BSK	64
	November	BSK	65
	December	BSK	66
	1993		
	January	BSK	60
	February	BSK	71
	March	BSK	29
	April	BSK	25
	May	BSK	20
	June	BSK	12
	July	BSK	12
	August	BSK	19
	September	BSK	20
	October	BSK	23
	November	BSK	15
	December	BSK	13
5489 Wallace Road (No. 2)	1987 September 18	APPL	ND
5502 Wallace Road (domestic)	1985 December 9	USAF	ND
	1986		
	January 10	USAF	ND
	February 4	USAF	0.5
	April 2	NA	ND
	May 20	NA	0.34
	June 20	NA	<0.12
	July 15	ND	ND
	August 12	CWL	ND
	September 2	CWL	ND
	October 7	CWL	ND
	November 17	NA	ND
	December 2	NA	ND
	1987		
	January 12	NA	ND
	February 10	NA	ND
	March 10	NA	ND
	April 13	NA	ND
	May	NA	ND
	June	NA	ND
	July 14	CWL	ND
5502 Wallace Road (cont.)	1990		
	January	BSK	6.2
	February	BSK	5.3
	March	BSK	ND
	April	BSK	3.6
	May	BSK	ND
	June	BSK	ND
	July	BSK	ND
	August	BSK	ND
	September	BSK	ND
	October	BSK	ND
	November	BSK	ND
	December	BSK	ND

Table 7.  
TCE RESULTS OF PRIVATE WELLS IN WALLACE ROAD AREA

Sampling point	Date of collection	Laboratory	TCE, $\mu\text{g/l}$
	1991		
	January	BSK	ND
	February	BSK	ND
	March	BSK	ND
	April	BSK	ND
	May	BSK	ND
	June	BSK	ND
	July	BSK	ND
	August	BSK	ND
	September	BSK	ND
	October	BSK	ND
	November	BSK	ND
	December	BSK	ND
	1992		
	January	BSK	ND
	February	BSK	ND
	March	BSK	ND
	April	BSK	ND
	May	BSK	ND
	June	BSK	ND
	July	BSK	ND
	August	BSK	ND
	September	BSK	ND
	October	BSK	ND
	November	BSK	ND
	December	BSK	ND
5502 Wallace Road (cont.)	1993		
	January	BSK	ND
	February	BSK	ND
	March	BSK	ND
	April	BSK	ND
	May	BSK	ND
	June	BSK	ND
	July	BSK	ND
	August	BSK	ND
	September	BSK	ND
	October	BSK	ND
	November	BSK	ND
	December	BSK	ND

NA = not available.  
 ND = not detected.  
 APPL = Agriculture & Priority Pollutants Laboratories  
 CAL = California Analytical Laboratory.  
 CWL = California Water Laboratory.  
 SHL = State Health Laboratory.  
 USAF = Brooks Air Force Base Laboratory.

APPENDIX A

ADMINISTRATIVE RECORD FILE INDEX

06/19/92

Administrative Record Index  
Castle Air Force Base, California

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Document Number: CAS-011-001

Title: Installation Restoration Program (IRP) Phase I Review  
Our Conversation, 1 Sep 92

Author: Stephan P. Hedrick, Capt, USAF  
SGPB, Bioenvironmental Engr.

Recipient: HQ SAC/SGPB (Col Burnett)

Date: 09/02/83

Location of Document: Castle Air Force Base

-----

Document Number: CAS-011-002

Title: Phase I Installation Restoration Program (IRP) Report;  
Subject Facility

Author: James B. Wolfson, Snr. Engr.  
CRWQCB Fresno

Recipient: Donald W. Kaiser, Lt Col, USAF  
HQ 93 Combat Support Group

Date: 01/04/84

Location of Document: Castle Air Force Base

-----

Document Number: CAS-011-003

Title: Minutes of Phase II IRP Pre-survey Meeting

Author: Stephen P. Hedrick, Capt, USAF  
Bioenvironmental Engineer

Recipient: 93 HOSP STRAT/SG

Date: 03/05/84



06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Location Of Document: Castle Air Force Base

-----

Document Number: CAS-011-004

Title: Environmental Health Review of the Installation Restoration Program Phase II (Stag-+1) for Castle Air Force Base

Author: Jeff Palsgaard, R.S.

Recipient: Major Pontier  
HQ SAC, Offutt AFB

Date: 07/23/84

Location of Document: Castle Air Force Base

-----

Document Number: CAS-011-005

Title: IRP Phase II, Stage 1 Draft Report Review Castle AFB, CA  
(Your Ltr, 3 Jul 85)

Author: Donald Kaiser, Lt Col, USAF  
Base Civil Engineer-DEEV

Recipient: USAF HOSP/SGPB

Date: 08/13/85

Location of Document: Castle Air Force Base

-----

Document Number: CAS-011-006

Title: Castle Air Force Base Installation Restoration Program  
Phase II Stage I

Author: Jeff Palsgaard, Envr. Hlth Spc  
Dept. of Hlth, Merced

6/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Recipient: HQ SAC/SGPB, Bioenvr. Engr.  
Offutt AFB, NE

Date: 12/17/85

Location of Document: Castle Air Force Base

-----

Document Number: CAS-011-007

Title: IRP Phase II Stage I Draft Report Review Comments,  
Castle AFB

Author: John H. Pontier, Maj, USAF  
Bioenvr. Engr. - SGPB

Recipient: USAF OEHL/TS

Date: 08/21/85

Location of Document: Castle Air Force Base

-----

Document Number: CAS-011-008

Title: EPA's final comments on both Castle Air Force Base  
Phase II Stage I Confirmation/Quantification Technical  
Report and Castle AFB Phase IV-A Remedial Action Plan  
Scope of Work (SOW)

Author: Keith Takata, Superfund Prgm.  
U.S. Envr. Protc. Agency, S.F.

Recipient: Col David E. Volz, USAF  
93 CSG - Castle AFB

Date: 01/01/86

Location of Document: Castle AFB

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Administrative Record Index  
Castle Air Force Base, California

=====

Document Number: Cas-011-009

Title: Phase II Installation Restoration Program (IRP),  
Castle AFB, CA

Author: Ronald D. Burnett, Col, USAF  
Bioenvr. Engr. - SGPB

Recipient: USAF OEHL/CV

Date: 01/04/84

Location of Document: Castle AFB

-----

Document Number: CAS-011-010

Title: EPA's comments on the draft Installation Restoration  
Program Phase II Confirmation/Quantification Stage 2  
Report for Castle AFB

Author: Amy K. Zimpfer, Fed. Resp Sect  
U.S. Envr. Prtc Agency, S.F.

Recipient: Arthur Chan, Envr. Task Force  
93 BMW/CVE, Castle AFB

Date: 11/02/87

Location of Document: Castle AFB

-----

Document Number: CAS-011-011

Title: Castle AFB Phase II, Stage 2 Report, Response to Comments  
Submitted by U.S. EPA, Region IX

Author: U.S. EPA, Region IX

Recipient: 93 CSG/EM  
Castle Air Force Base

Date 07/01/88

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Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle Air Force Base

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Document Number: CAS-011-012

Title: Roy F. Weston, Inc. follow-up on Phase II, Stage 2,  
Installation Restoration Program Studies at Castle AFB

Author: Lisa A. Hamilton, Task Mngr.  
Roy F. Weston, Inc.

Recipient: Al Petersen, Envr. Task Force  
Castle Air Force Base

Date: 08/21/87

Location of Document: Castle AFB

-----

Document Number: CAS-011-013

Title: CA Dept. of Health Services Toxic Substances Control  
Division, Northern CA Section Response Comments of  
Castle AFB Phase II, Stage 2 Report

Author: Roy F. Weston, Inc.

Recipient: 93 CSG/EM  
Castle Air Force Base

Date: 01/07/88

Location of Document: Castle Air Force Base

-----

Document Number: CAS-012-001

Title: JP-4 Fuel Line Assessment for Castle Air Force Base

Author: IT Corporation

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Administrative Record Index  
Castle Air Force Base, California

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Recipient: Strategic Air Command HQ

Date: 05/01/88

Location of Document: Castle Air Force Base

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Document Number: CAS-012-002

Title: Contract N62472-85-C-5239, FY-87 MCAF Project-1st Fuel  
Storage Study, Castle Air Force Base, Merced, CA with  
35% Submittal Report for FY87 MCAF Project Jet Fuel  
Storage at Castle AFB, Merced, CA

Author: R.J. Roberts, Inc.

Recipient: 93 CSG/DEE  
Bldg 545, Castle AFB, CA

Date: 12/04/85

Location of Document: Castle Air Force Base

-----

Document Number: CAS-012-003

Title: Preliminary Soil Investigation Report, Tank Groups 1, 2,  
and 3, Castle AFB

Author: Roy F. Weston, Inc.  
Stockton, CA

Recipient: 93 CSG/EM  
Castle Air Force Base

Date: 11/27/85

Location of Document: Castle Air Force Base

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Administrative Record Index  
Castle Air Force Base, California

=====

Document Number: CAS-012-004

Title: ADL Jet Fuel Storage and Dispensing Facility Vol 1 35%  
Submittal

Author: Boyle Engineering Group  
Fresno, CA

Recipient: Castle Air Force Base,  
Merced, CA

Date: 10/01/87

Location of Document: Castle Air Force Base

-----

Document Number: CAS-013-001

Title: Completion of Merced County Survey for Abandoned  
Hazardous Waste Disposal Sites Conducted by Toxic  
Substances Control Division of the Department of  
Health Services

Author: Thomas E. Bailey, Toxic Subst.  
Cntrl Divs. Dept Hlth Serv

Recipient: Charles Mosher, MD & Riley  
Peters Acting Hlth Ofcr, Merced, CA

Date: 10/19/83

Location of Document: Castle Air Force Base

-----

Document Number: CAS-014-001

Title: Installation Restoration Program, Phase I; Records Search

Author: ES - Engineering Science

Recipient: USAF - Tyndall AFB, FL

Date: 10/01/83

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====  
Location of Document: Castle Air Force Base  
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Document Number: CAS-014-002

Title: FY-1987 MCAF Project Jet Fuel Storage  
Castle AFB Contract No. N62474-85-G-5239

Author: R.J. Roberts, Inc.

Recipient: Castle Air Force Base  
Merced, CA

Date: 02/11/86

Location of Document: Castle Air Force Base  
-----

Document Number: CAS-015-001

Title: Installation Restoration Program Phase II - Confirmation/  
Quantification Stage 1. (Volume I and II)

Author: Roy F. Weston, Inc.  
West Chester, Pennsylvania

Recipient: Castle Air Force Base, CA

Date: 11/01/85

Location of Document: Castle Air Force Base  
-----

Document Number: CAS-015-002

Title: Installation Restoration Program Phase II - Confirmation/  
Quantification Stage 2. (Volume I, II, and III).

Author: Roy F. Weston, Inc.  
West Chester, Pennsylvania

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Recipient: Castle Air Force Base, CA

Date: 07/01/88

Location of Document: Castle Air Force Base

-----

Document Number: CAS-015-003

Title: Health and Safety Plan

Author: Roy F. Weston, Inc.  
West Chester, Pennsylvania

Recipient: Castle AFB, CA

Date: 10/01/86

Document Number: CAS-015-004

-----

Title: Draft: Installation Restoration Program Phase 2 -  
Confirmation/Quantification, Stage 2 (Vols. 1, 2, 3, and 4)

Author: Roy F. Weston, Inc.  
West Chester, Pennsylvania

Recipient: Castle Air Force Base  
Merced, CA

Date: 06/01/87

Location of Document: Castle Air Force Base

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Administrative Record Index  
Castle Air Force Base, California

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Document Number: CAS-015-005

Title: Contamination Investigating and Sampling of Transformers  
and Tanks Corrosion Control Facility, Castle AFB

Author: Hardin Lawson Associates  
Novato, CA

Recipient: URS/John A. Blume & Associates  
San Francisco, CA

Date: 09/06/85

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-015-006

Title: TPCA Investigation Workplan - Fire Training Area  
Castle Air Force Base, CA

Author: Kleinfelder, Inc.  
Fresno, CA

Recipient: 93 CSG/LGC  
Castle Air Force Base, CA

Date: 03/08/89

Location of Document: Castle Air Force Base

-----

Document Number: CAS-015-007

Title: Solid Waste Assessment (SWAT) Proposals,  
Castle Air Force Base, CA

Author: Kleinfelder, Inc.  
Fresno, CA

Recipient: 93 CSG/LGCC  
Castle Air Force Base

Date: 03/08/89

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====  
Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-015-008

Title: Solid Waste Assessment Test Report - CAFB West Landfill  
Zone

Author: Kleinfelder, Inc.,  
Fresno, CA

Recipient: Castle AFB, CA

Date: 03/18/91

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-015-009

Title: Solid Waste Assessment Test Report Castle AFB South  
Landfill Zone

Author: Kleinfelder, Inc.,  
Fresno, CA

Recipient: 93 CSG/DEV  
Castle AFB, CA

Date: 05/14/91

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-015-010

Title: Solid Waste Assessment Test Report Castle AFB Landfill 3

Author: Kleinfelder, Inc.  
Fresno, CA

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Recipient: 93 CSG/DEV  
Castle AFB, CA

Date: 04/19/91

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-021-001

Title: Need for TCE Removal Action at Castle AFB

Author: Michael Work  
EPA, San Francisco

Recipient: Layi Oyelowo  
93 CSG/EM, Castle AFB

Date: 08/08/90

Location of Document: Castle AFB

-----

Document Number: CAS-024-001

Title: Groundwater Investigating Northeast Quadrant (Vols. 1 and  
2)

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: City of Atwater

Date: 05/01/88

Location of Document: Castle Air Force Base

-----

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Document Number: CAS-024-002

Title: Preliminary Design Report for Production Well and Water Main

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: City of Atwater

Date: 06/01/88

Location of Document: Castle Air Force Base

-----

Document Number: CAS-024-003

Title: Contract Documents for Construction of Northeast Atwater Well and Water Main

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: Castle Air Force Base  
Merced, CA

Date: 08/08/88

Location of Document: Castle Air Force Base

-----

Document Number: CAS-024-004

Title: Chemical Groundwater Quality Evaluation

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: City of Atwater

Date: 01/01/87

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Location of Document: Castle Air Force Base

-----

Document Number: CAS-024-005

Title: Contract Documents for Construction of Monitoring and  
Test Wells

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: City of Atwater

Date: 11/01/87

Location of Document: Castle Air Force Base

-----

Document Number: CAS-024-006

Title: Groundwater Treatment Feasibility Report for Organics  
Removal from Main Base Well 1, 2, and 3

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: Castle Air Force Base, CA  
Merced, CA

Date: 03/01/89

Location of Document: Castle Air Force Base

-----

Document Number: CAS-031-001

Title: Progress Report - Hydrologic Evaluation (CAFB Wells 1, 2,  
3, and 4)

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Document Number: CAS-024-002

Title: Preliminary Design Report for Production Well and Water Main

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: City of Atwater

Date: 06/01/88

Location of Document: Castle Air Force Base

-----

Document Number: CAS-024-003

Title: Contract Documents for Construction of Northeast Atwater Well and Water Main

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: Castle Air Force Base  
Merced, CA

Date: 08/08/88

Location of Document: Castle Air Force Base

-----

Document Number: CAS-024-004

Title: Chemical Groundwater Quality Evaluation

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: City of Atwater

Date: 01/01/87

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====  
Location of Document: Castle Air Force Base  
-----

Document Number: CAS-024-005

Title: Contract Documents for Construction of Monitoring and  
Test Wells

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: City of Atwater

Date: 11/01/87

Location of Document: Castle Air Force Base  
-----

Document Number: CAS-024-006

Title: Groundwater Treatment Feasibility Report for Organics  
Removal from Main Base Well 1, 2, and 3

Author: Boyle Engineering Corp.  
Fresno, CA

Recipient: Castle Air Force Base, CA  
Merced, CA

Date: 03/01/89

Location of Document: Castle Air Force Base  
-----

Document Number: CAS-031-001

Title: Progress Report - Hydrologic Evaluation (CAFB Wells 1, 2,  
3, and 4)

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Author: Gunter A. Redlin, P.E.,  
Boyle Engineering Corp, Fresno

Recipient: Linda TeKrony  
93 CSG/EM, Castle AFB

Date: 04/07/89

Location of Document: Castle Air Force Base

-----

Document Number: CAS-033-001

Title: Results of Laboratory Analysis of Water Sample Collected  
in July 1987.

Author: Mark V. Johnson, Hydr. Tech.  
Water Resources Division

Recipient: Maj. Burrell, Bio-Env. Engr.  
Castle Air Force Base

Date: 07/19/88

Location of Document: Castle Air Force Base

-----

Document Number: CAS-033-003

Title: SOV Testing for JP-4 Pipeline

Author: A.W. Petersen, Env. Engineer

Recipient: Memo for Record

Date: 11/05/87

Location of Document: Castle Air Force Base

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06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Document Number: CAS-033-004

Title: Laboratory Analysis Report and Record-Test for Volatile  
Halocarbons

Author: George Lee, USAFOEHL/SA  
Brooks AFB, TX

Recipient: 93 STRAT HOSP/SGPB  
Castle AFB, CA

Date: 03/28/89

Location of Document: Castle AFB, CA

-----

Document Number: CAS-033-005

Title: PW-1, 2, 3, and 4 Volatile Organic Compound Sample  
Analysis

Author: California Water Labs

Recipient: 93 CSG/EM  
Castle AFB, GA

Date: 03/15/89

Location of Document: Castle AFB, CA

-----

Document Number: CAS-033-006

Title: Grain Size Analysis from IT

Author: IT Corporation  
Martinez Office

Recipient: Linda TeKrony  
Environmental Engineer

Date: 12/21/88

06/19/92

Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle AFB, CA

-----

Document Number: CAS-033-007

Title: Sample Results PW-1, 2, 3, and 4-ICP Priority  
Pollutant Metal and Scan and Nitrates

Author: OEHL

Recipient: 93 CSG/EM  
Castle Air Force Base

Date: 04/05/89

Location of Document: Castle Air Force Base

-----

Document Number: CAS-033-008

Title: Soil Augering at the Oil/Water Separator (DA-5)

Author: John Loyd, Project Manager  
Oak Ridge National Laboratory

Recipient: Maj Doug Brown, HQ SAC/DEPV  
Offutt AFB, NE

Date: 10/14/86

Location of Document: Castle Air Force Base

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Document Number: CAS-033-009

Title: Monitoring Well Boring Logs (Deleted - Page of Site  
Project Report, Doc No. CAS-035-001)

Author:

Recipient:

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====

Date:    /    /

Location of Document:

-----

Document Number:  CAS-033-010

Title:  Results of Laboratory Analysis of Water Sample Collected  
          in Dec 89

Author:  California Water Labs  
          Modesto, CA

Recipient:  93 STRAT HOSP/SGPB  
              Castle Air Force Base

Date:  01/03/90

Location of Document:  Castle Air Force Base

-----

Document Number:  CAS-034-001

Title:  Addendum Remedial Investigation/Feasibility Study Work  
          Plans Castle Air Force Base

Author:  IT Corporation  
          Martinez, CA

Recipient:  Strategic Air Command HQ  
              Offutt AFB, NE

Date:  12/01/88

Location of Document:  Castle Air Force Base, CA

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Document Number:  CAS-034-002

Title:  Remedial Investigation/Feasibility Study for Castle Air  
          Force Base Volume IV:  Health and Safety Plan

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Administrative Index  
Castle Air Force Base, California

=====

Document Number: CAS-034-005

Title: Remedial Investigation/Feasibility Study for Castle AFB  
Vol I: Work Plan

Author: Martin Marietta Energy Systems  
Oak Ridge, TN

Recipient: Castle Air Force Base  
Merced, CA

Date: 04/01/88

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-034-006

Title: Quality Control Requirements for Field Methods

Author: Martin Marietta - HAZWRAP  
Oak Ridge, TN

Recipient: 93 CSG/EM  
Castle Air Force Base, CA

Date: 02/28/89

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-034-007

Title: Requirements for Quality Control of Analytical Data

Author: Martin Marietta - HAZWRAP  
Oak Ridge, TN

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 07/31/88

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Administrative Record Index  
Castle Air Force Base, California

=====

Author: IT Corporation  
Martinez, CA

Recipient: Strategic Air Command HQ  
Offutt AFB, NE

Date: 04/01/88

Location of Document: Castle Air Force Base

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Document Number: CAS-034-003

Title: Remedial Investigation/Feasibility Study for Castle AFB  
Volume III: Quality Assurance Project Plan

Author: IT Corporation  
Martinez, CA

Recipient: Strategic Air Command HQ  
Offutt AFB, NE

Date 10/01/88

Location of Document: Castle Air Force Base

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Document Number: CAS-034-004

Title: Remedial Investigation/Feasibility Study for Castle Air  
Force Base Volume II: Sampling and Analysis Plan

Author: IT Corporation  
Martinez, CA

Recipient: Strategic Air Command HQ  
Offutt AFB, NE

Date: 04/01/88

Location of Document: Castle Air Force Base

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Administrative Record Index  
Castle Air Force Base, California

=====  
Location of Document: Castle AFB, CA  
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Document Number: CAS-034-008

Title: Installation Restoration Program Work Plan for CAFB

Author: Martin Marietta Energy Systems  
Oak Ridge, TN

Recipient: CSG/DEV  
Castle AFB, CA

Date: 11/01/90

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-034-009

Title: Long-Term Groundwater Sampling Plan for Castle AFB,  
Atwater, CA

Author: Martin Marietta Energy Systems  
Oak Ridge, TN

Recipient: 93 CSG/DEV  
Castle AFB, CA

Date: 03/01/91

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-034-010

Title: Remedial Investigation/Feasibility Study for Operable  
Unit 2, Castle Air Force Base, CA

Author: Metcalf & Eddy  
Santa Clara, CA

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Administrative Record Index  
Castle Air Force Base, California

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Recipient: 93 SPTG/DEV  
Castle AFB, CA

Date: 09/06/91

Location of Document: Castle AFB, CA

-----

Document Number: CAS-034-011

Title: Draft Final Remedial Investigation/Feasibility Study  
Baseline Risk Assessment for Operable Unit No. 2  
Castle AFB, CA Vol 1 of 2

Author: Metcalf & Eddy  
Santa Clara, CA 95054

Recipient: 93 SPTG/DEV  
Castle AFB, CA

Date: 12/02/91

Location of Document: Castle AFB, CA 95342-5000

-----

Document Number: CAS-034-012

Title: Draft Final Remedial Investigation/Feasibility Study  
Baseline Risk Assessment for Operable Unit No. 2  
Castle AFB, CA

Author: Metcalf & Eddy  
Santa Clara, CA 95054

Recipient: 93 SPTG/DEV  
Castle AFB, CA

Date: 12/02/91

Location of Document: Castle AFB, CA

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Document Number: CAS-034-013

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Administrative Record Index  
Castle Air Force Base, California

=====

Title: Draft Final Remedial Investigation/Feasibility Study  
Baseline Risk Assessment for Operable Unit 2, Vol 1 of 2  
Castle Air Force Base, Merced County CA

Author: Metcalf & Eddy  
Santa Clara, CA

Recipient: 93 SPTG/DEV  
Castle AFB, CA

Date: 01/30/92

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-034-014

Title: Draft Final Remedial Investigation/Feasibility Study  
Baseline Risk Assessment for Operable Unit 1, Vol.  
2 of 2, Castle Air Force Base, Merced County, CA

Author: Metcalf & Eddy  
Santa Clara, CA

Recipient: 93 SPTG/DEV  
Castle Air Force Base, CA

Date: 01/30/92

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-034-015

Title: Groundwater Remediation System Operable Unit No. 1  
Draft 100% Design, Design Specifications, Vol I  
Castle AFB, CA Contract #N62474-88-D-5086

Author: Comprehensive Long-Term  
Environmental Action Navy

Recipient: Lt Col Thomas R. Baker  
93 CES/CEV

Date: 05/27/92



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Castle Air Force Base California

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Location of Document: Castle AFB, CA

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Document Number: CAS-034-016

Title: Groundwater Remediation System Operable Unit No. 1  
Draft 100% Design, Design Specifications, Vol. II  
Castle AFB, CA Contract #N62474-88-D-5086

Author: Comprehensive Long-Term  
Environmental Action Navy

Recipient: Lt Col Thomas R. Baker  
93 CES/DEV

Date: 05/27/92

Location of Document: Castle AFB, CA

-----

Document Number: CAS-034-017

Title: Castle AFB Operable Unit No. 1 Groundwater  
Remediation System Draft 100% Design Cost Estimating  
Contract #N62474-88-D-5086

Author: Comprehensive Long-Term  
Environmental Action-Navy

Recipient: Lt Col Thomas R. Baker  
93 CES/DEV

Date: 05/29/92

Location of Document: Castle AFB, CA

-----

Document Number: CAS-034-018

Title: Castle AFB Operable Unit No. 1, Groundwater Remediation  
System, Draft 100% Design-Vicinity Map, Site Location  
Map and Sheet Index

Author: Comprehensive Long-Term

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Administrative Record Index  
Castle Air Force Base, California

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Recipient: Lt Col Thomas R. Baker  
93 CES/CEV

Date: 05/29/92

Location of Document: Castle AFB, CA

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Document Number: CAS-034-019

Title: Draft Remedial Action Work Plan, Operable Unit No. 1  
Contract No. N62474-88-D-5086, Castle AFB

Author: Comprehensive Long-Term  
Environmental Action-Navy

Recipient: Lt Col Thomas R. Baker  
93 CES/DEV

Date: 05/29/92

Location of Document: Castle AFB, CA

-----

Document Number: CAS-034-020

Title: Draft Basis of Design Report, Operable Unit No. 1  
Contract No. N62474-88-D-5086, Castle AFB, CA

Author: Comprehensive Long-Term  
Environmental Action Navy

Recipient: Lt Col Thomas R. Baker  
93 CES/DEV

Date: 05/29/92

Location of Document: Castle AFB, CA

-----

Document Number: CAS-035-001

Title: Preliminary Site Characterization Report for CAFB - Vols.  
1, 2, and 3

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Administrative Record Index  
Castle Air Force Base, California

=====

Author: HAZWRAP - Martin Marietta  
Energy Systems, Oak Ridge, TN

Recipient: HQ SAC  
Offutt AFB, NE

Date: 01/09/90

Location of Document: Castle AFB, CA

-----

Document Number: CAS-035-002

Title: EPA Comments on OUFS-1 Proposed Plan

Author: Michael Work, EPA Region IX  
Remedial Project Manager

Recipient: Layi Oyelowo  
93 CSG/DEV, CAFB

Date: 11/27/90

Location of Document: Castle AFB, CA

-----

Document Number: CAS-035-003

Title: Interim Operable Unit No. 1 Feasibility Study of CAFB

Author: Martin Marietta Energy System  
Oak Ridge, TN

Recipient: Castle AFB, CA

Date: 01/12/90

Location of Document: Castle AFB, CA

-----

Document Number: CAS-035-004

Title: Proposed Plan for Castle Air Force Base

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Administrative Record Index  
Castle Air Force Base, California

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Author: Martin Marietta Energy System  
Oak Ridge, TN

Recipient: Castle Air Force Base, CA

Date: 01/12/90

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-035-005

Title: Dept. of Toxic Substances Control's Comments on Draft  
Final Proposed Plan (PP) Operable Unit No. 2 (OU-2)  
Castle Air Force Base, California

Author: Mr. John O'Kane  
Dept, Toxic Substances Control

Recipient: 93 SPTG/DEV

Date: 03/23/92

Location of Document: Castle AFB, CA

-----

Document Number: CAS-035-006

Title: Fact Sheet on Proposed Plan for Operable Unit No. 2  
Announcing Public Comment Period and Community  
Meeting on 18 May 1992

Author: Public Affairs Office  
Castle AFB, CA

Recipient: General Public

Date: 04/30/92

Location of Document: Castle AFB & Merced Library

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Document Number: CAS-042-001

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Administrative Record Index  
Castle Air Force Base, California

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Title: Health and Safety Code, Article 9.5

Author: State of California

Recipient:

Date: 01/01/84

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-042-002

Title: Press Release, New Standards for 11 Chemical Contaminants  
of Drinking Water to Become Effective 25 Feb 89

Author: Department of Health Services  
Sacramento, CA

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 02/25/89

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-051-001

Title: AF Response to Specific Comments Interim Operable Unit 1  
Record of Decision, Castle AFB, CA

Author: IT Corporation  
Martinez, CA

Recipient: Castle AFB, CA

Date: 06/01/91

Location of Document: Castle Air Force Base, CA

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Administrative Record Index  
Castle Air Force Base, California

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Document Number: CAS-051-002

Title: Appendix H, Environmental Information Form Record of  
Decision Interim Operable Unit No. 1, for Castle Air  
Force Base

Author: Thomas R. Baker, Lt Col, USAF  
93 CSG/DEV, Castle AFB, CA

Recipient:

Date: 08/07/91

Location of Document: Castle AFB, CA

-----

Document Number: CAS-051-003

Title: Appendix I, Environmental Checklist Form, Record of  
Decision Interim Operable Unit No. 1 for Castle Air Force  
Base, CA

Author: Anthony J. Landis, Chief, Site Mit. Brch,  
Toxic Substance Ctrl P.

Recipient:

Date: 08/07/91

Location of Document: Castle AFB, CA

-----

Document Number: CAS-051-004

Title: Final Technical Document To Support No Further Action  
Site Nos. 22, 23, 24, 25, 26, and 27

Author: Martin Marietta Energy System Inc.  
Oak Ridge, TN

Recipient: Thomas R. Baker, Lt Col, USAF  
93 CSG/DEV, Castle AFB, CA

Date: 09/16/91

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Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle Air Force Base, California  
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Document Number: CAS-052-001

Title: Record of Decision Interim Operable Unit No. 1 for CAFB

Author: Martin Marietta Energy System  
Oak Ridge, TN

Recipient: 93 CSG/DEV  
Castle AFB, CA

Date: 08/07/91

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-061-002

Title: Status Report-Cleanup and Abatement Order No. 84-027  
(Reference CRWQCB ltr dtd 21 April 1987)

Author: Ronald L. Hawkins, Lt Col, USAF  
Environmental Task Force

Recipient: James B. Wolfson (Fresno)  
CA Regional Water Quality Control Board

Date: 05/22/87

Location of Document: Castle Air Force Base, CA  
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Document Number: CAS-073-001

Title: Castle AFB Recommendations for Historic Preservation

Author: K Landreth & J Isaacson  
US Army Const Eng Res Lab

Recipient: 93 CSG/DEV  
Castle AFB, CA

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Date: 11/01/90

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-078-001

Title: Notification of Addition of Castle Air Force Base to the  
NPL

Author: Jeff Zelikson  
EPA, San Francisco, CA

Recipient: Dennis McGuirk, Col, USAF  
93 BMW/CV, Castle AFB, CA

Date: 07/22/87

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-081-001

Title: Health Assessments of USAF National Priority List Sites

Author: Author Chan  
Environmental Task Force

Recipient: Doug Hawkins  
Office of Health & Emergency Planning

Date: 04/26/89

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-082-001

Title: Preliminary Health Assessment for Castle AFB

Author: ATSDR-US Public Health Serv.

Recipient: Castle Air Force Base, CA



Date: 10/27/88

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Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle Air Force Base  
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Document Number: CAS-112-001

Title: Community Relations Plan for the Remedial Investigation  
Feasibility Study at Castle Air Force Base

Author: IT Corporation  
Martinez, CA

Recipient: Strategic Air Command HQ  
Offutt AFB, NE

Date: 10/01/88

Location of Document: Castle Air Force Base  
-----

Document Number: CAS-112-002

Title: Base Eyes Possible Past Refuse Sites

Author: Valley Bomber

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 08/10/90

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-113-001

Title: Castle AFB Announces Extension of Public Comment Period  
on Proposed Cleanup

Author: 93 BMW/PA  
Castle AFB, CA

Recipient: Merced Sun Star/Atwater Signal, Merced, CA

Date: 01/23/91

06/19/92

Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle AFB, CA  
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Document Number: CAS-114-001

Title: Minutes of the Technical Review Committee (Quarterly)

Author: Linda L. Leong, Major, USAF  
93 BMW/PA

Recipient: 93 CSG/EM  
Castle Air Force Base, CA

Date: / /

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-114-003

Title: Solid Waste Assesment Test Work Plan for Castle Vista  
Landfill

Author: Martin Marietta Energy System  
Oak Ridge, TN

Recipient: Castle AFB, CA

Date: 05/01/90

Location of Document: Castle Air Force Base, CA  
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Document Number: CAS-114-004

Title: Proposed Agenda for Public Meeting

Author: 93 BMW/PA  
Castle AFB, CA

Recipient: 93 CSG/DEV  
Castle AFB, CA

Date: / /

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Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle Air Force Base, CA

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Document Number: CAS-114-005

Title: Public Presentation on Operable Unit 1 Ground Cleanup

Author: 93 BMW/PA  
Castle AFB, CA

Recipient: 93 CSG/DEV  
Castle AFB, CA

Date: 01/08/91

Location of Document: Castle AFB, CA

-----

Document Number: CAS-117-001

Title: Quarterly TCE Summary Report (Letters to Residents)

Author: Brian L. Sassaman, 2Lt, USAF  
93 STRAT HOSP/SGPB

Recipient: Various

Date: 07/31/90

Location of Document: Castle AFB, CA

-----

Document Number: CAS-119-001

Title: Castle AFB's Environmental Update

Author: Public Affairs Office  
93 BMW/PA, CAFB

Recipient: 93 CSG/DEV  
Castle AFB, CA

Date: 10/01/90

06/19/92

Administrative Record Index  
Castle Air Force Base, California

=====  
Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-119-002

Title: Castle AFB's Environmental Update

Author: Public Affairs Office  
93 BW/PA, CAFB

Recipient: 93 SPTG/DEV

Date: 03/15/92

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-121-001

Title: Interim Guidelines and Specifications for Preparing  
Quality Assurance Project Plans (QAPJP)

Author: EPA

Recipient:

Date: 12/29/80

Location of Document: Castle AFB, CA  
-----

Document Number: CAS-121-002

Title: Policy for Superfund Compliance with the RCRA and Disposal  
Restrictions

Author: United States Environmental  
Protection Agency, Washington, D.C.

Recipient: Regional-Administrators,  
Regions I-X

Date: 04/17/89

06/19/92

Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle Air Force Base, CA

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Document Number: CAS-121-003

Title: A Guide On Remedial Actions for Contaminated Ground Water

Author: United States Environmental  
Protection Agency (EPA)

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 04/01/89

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-121-004

Title: Interim Final Guidance on Preparing Superfund Decision  
Documents: Proposed Plan; Record of Decision,  
Explanation of Significant Differences; Record of  
Decision Amendment

Author: Office of Emergency & Remedial  
Response (EPA), Washington, DC

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 06/01/89

Location of Document: Castle AFB, CA

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Document Number: CAS-121-005

Title: RCRA Facility Assessment Guidance

Author: United States Environmental  
Protection Agency

Recipient: 93 CSG/EM  
06/19/92

Administrative Record Index  
Castle Air Force Base, California

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Date: 10/01/86

Location: Castle Air Force Base, CA

-----

Document Number: CAS-121-006

Title: Superfund Exposure Assessment Manual

Author: United States Environmental  
Protection Agency

Recipient: 93 CSG/EM  
Castle Air Force Base, CA

Date: 04/01/88

Location of Document: Castle Air Force Base CA

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Document Number: CAS-121-007

Title: Risk Assessment Guidance for Superfund-Environmental  
Evaluation Manual Interim Final

Author: United States Environmental  
Protection Agency

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 03/01/89

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-121-008

Title: Administrative Records for Installation Restoration  
Program

Author: HQ SAC/DEVC  
Offutt AFB, NE

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Administrative Record Index  
Castle Air Force Base, California

=====

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 06/08/89

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-121-009

Title: Comprehensive Environmental, Response, Compensation,  
and Liability Act of 1980 (CERCLA)

Author: Published by The Bureau of National Affairs  
Washington, DC

Recipient: Castle Air Force Base

Date: 02/24/89

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-121-009

Title: National Contingency Plan

Author: Environmental Protection Agency

Recipient: 93 CSG/EM  
Castle AFB, CA

Date: 03/08/90

Location of Document: Castle AFB, CA

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Document Number: CAS-122-001

Title: What to Include in a U.S. EPA Region 9 Sample Plan if you  
are not going to use the Contract Lab Program

Author: EPA Region 9

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Administrative Record Index  
Castle Air Force Base, California

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Recipient:

Date: 01/01/86

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-123-001

Title: Landfills at Castle Air Force Base, Merced County

Author: Michael H. Mosbacher, P.E.  
CA Regional Water Control Board, Sacramento

Recipient: Arthur Chan, Envr. Task Force  
HQ 93rd BMW-Castle AFB

Date: 10/05/88

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-123-002

Title: Solid Waste Assessment Test Guidance

Author: State Water Resources Control Board

Recipient:

Date: 03/01/86

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-123-003

Title: Staff Report on Testing Guidelines for Active Solid Waste  
Disposal Sites

Author: Toxic Pollutants Branch  
Stationary Source Division

Recipient:



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Administrative Record Index  
Castle Air Force Base, California

=====  
Date: 12/01/86

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-124-001

Title: Human Exposures to Volatile Halogenated Organic Chemicals  
in Indoor and Outdoor Air

Author: Julian B. Andelman

Recipient:

Date: 01/01/85

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-124-002

Title: Human Exposure to Volatile Organic Compounds in Household  
Tap Water: The Indoor Inhalation Pathway

Author: Thomas E. McKone

Recipient:

Date: 01/01/87

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-124-003

Title: The Role of Skin Absorption as a Route of Exposure for  
Volatile Organic Compounds (VOCs) in Drinking Water

Author: Brown, Bishop and Rowan

Recipient:

Date: 05/01/84

06/19/82

Administrative Record Index  
Castle Air Force Base, California

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Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-124-004

Title: Alternatives for Removal of TCE from Groundwater at  
Castle Air Force Base, Merced, California

Author: Oak Ridge National Laboratory  
John Loyd

Recipient: Ahmet Turkoglu  
Castle AFB, CA

Date: 01/28/87

Location of Document: Castle Air Force Base, CA  
-----

Document Number: CAS-124-005

Title: A Contaminant Transport Model of Trichloroethylene  
Movement in Groundwater at Castle Air Force Base, CA

Author: Lizanne Avon

Recipient: 93 CSG/EM  
Castle Air Force Base, CA

Date: 05/01/88

Location of Document: Castle Air Force Base, CA  
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AMENDED ADMINISTRATIVE RECORD INDEX  
CASTLE AIR FORCE BASE, CALIFORNIA

=====  
Document Number: CAS-125-001

Title: Final Basis of Design Report Operable Unit No. 1  
Vol. I

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AMENDED ADMINISTRATIVE RECORD INDEX  
CASTLE AIR FORCE BASE, CALIFORNIA

=====

Author: PRC Environmental Management Inc. for Navy CLEAN

Recipient:

Date: 12/10/92

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-125-002

Title: Final Basis of Design Report Operable Unit No. 1  
Vol. II

Author: PRC Environmental Management Inc. for Navy CLEAN

Recipient:

Date: 09/29/92

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-125-003

Title: Operable Unit No. 1, Groundwater Remediation System  
Final 100% Design Cost Estimate (and map)

Author: PRC Environmental Management Inc. for Navy CLEAN

Recipient:

Date: 09/29/92

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-125-004

Title: Groundwater Remediation System Operable Unit No. 1  
Design Specifications Vols. I and II

Author: PRC Environmental Management Inc. for Navy CLEAN

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AMENDED ADMINISTRATIVE RECORD INDEX  
CASTLE AIR FORCE BASE, CALIFORNIA

=====

Recipient:

Date: 09/29/92

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-125-005

Title: Final Remedial Action Work Plan Operable Unit No. 1

06/18/93

-----

Author: PRC Environmental Management Inc. for Navy CLEAN

Recipient:

Date: 12/10/92

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-126-001

Title: Draft Final Record of Decision for Operable Unit No. 2

Author: U.S. EPA Region 9

Recipient:

Date: 10/92

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-127-001

Title: Castle AFB's Environmental Update

Author: Scarlett Parker, TSgt, USAF  
93 BW/PA  
Castle AFB, CA

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CASTLE AIR FORCE BASE, CALIFORNIA

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Recipient:

Date: 03/19/93

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-128-001

Title: Technical Memorandum Air Stripper Pilot Study Operable  
Unit No. 1

Author: PRC Environmental Management Inc. for Navy CLEAN

Recipient:

Date: 05/18/93

Location of Document: Castle Air Force Base, CA

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Document Number: CAS-128-002

Title: Technical Memorandum Aquifer Pumping Test, Operable Unit  
No. 1

Author: PRC Environmental Management Inc. for Navy CLEAN

Recipient:

Date: 05/18/93

Location of Document: Castle Air Force Base, CA

-----

Document Number: CAS-129-001

Title: OU-2 ROD Responsiveness Summary (public comments and  
responses)

Author: Environmental Flight and Public Affairs Castle AFB

AMENDED ADMINISTRATIVE RECORD INDEX  
CASTLE AIR FORCE BASE, CALIFORNIA

=====  
Date: Oct 92

Location of Document: Castle AFB, CA  
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Document Number: CAS-129-002

Title: Remedial Investigation/Feasibility Study Baseline Risk  
Assessment for OU-2 Volumes 1 & 2

Author: Metcalf & Eddy

Recipient: Castle AFB, CA

Date: Dec 91

Location of Document: Castle AFB, CA  
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Document Number: CAS-129-003

Title: Proposed Plan for OU-2

Author: Environmental Flight Castle AFB

Recipient:

Date: Apr 92

Location of Document: Castle AFB, CA

## APPENDIX B

### RESPONSIVENESS SUMMARY

## **OPERABLE UNIT 2 ROD RESPONSIVENESS SUMMARY**

### **OVERVIEW**

**At the time of the public comment period, Castle AFB had narrowed the selection to a preferred alternative:**

Castle AFB, U.S. EPA and Cal-EPA, DTSC, agree that the preferred alternative consists of groundwater removal by pumping and surface treatment of the groundwater using air stripping. The emissions from the air stripper will be controlled using activated carbon adsorption. The treated groundwater will be reinjected into the same aquifer from which it is removed.

Judging from the comments received during the public comment period, local residents are most concerned about the extent and location of the plume, depletion of the groundwater supply caused by the remediation, amount of time required to complete cleanup actions and possible production of additional hazardous waste while cleaning up the current contaminants. However, no commentor expressed disagreement with the selected alternative.

### **BACKGROUND ON COMMUNITY INVOLVEMENT**

In October 1983, Castle AFB completed Phase I of the Installation Restoration Program which identified sites of potential environmental concern. In February 1984, base officials notified workers and residents at Castle that TCE levels in some groundwater were above the



5 parts per billion maximum contaminant level. Off-base, community concern has generally been limited to those residents directly affected by the TCE contamination including residents of Castle Mobile Home Park, Santa Fe Drive and Wallace Road. However, with the announcement of Castle's closure, these concerns are now shifting. Off-base community residents seem to be more concerned with the length of time required to clean up the base's contamination, adequate funding to completely clean up the base and how this will affect their reuse of the land after the Air Force leaves in September 1995.

Sixteen community concerns and comments were raised about the cleanup actions during the public meeting held May 18, 1992, in the Atwater City Hall. Castle also received written comments from an attorney, the Regional Water Quality Control Board and California Department of Toxic Substances Control. These concerns and comments, and Castle's responses are shown below.

#### Community Comment No. 1

"Is the time line for the schedule of future activities in the OU-2 Proposed Plan a realistic time frame?"

#### Response

The dates given in the schedule of future activities are estimates. Our consulting engineers based the time line on several factors: (1) the volume of water to be treated, (2) the rate at which it will be treated, (3) levels of contamination, and (4) types of chemicals.

Community Comment No. 2

"If you're drawing water out of the plume for irrigation purposes, are there any ill effects on the fruit that's grown in that area?"

Response

There have been no ill effects on the fruit so far. In response to a question about the safety of almond orchards on Wallace Road last year, air samples were taken to measure the TCE concentrations in the air during irrigation. Sampling results revealed no detectable traces of TCE in these air samples. We then had some almonds from these orchards analyzed for TCE absorption into the fruit, and these results were also negative.

Community Comment No. 3

"Is this the only TCE plume we're dealing with?"

Response

No, Operable Unit No. 1 deals with the main base TCE plume. This strictly deals with a different area of the base. OU-2 involves the TCE plume in the Wallace Road and Discharge Area 4 areas of the base.

#### Community Comment No. 4

"What's the by-product off the stripping tower?"

#### Response

There are two by-products from the stripping tower: (1) treated groundwater and (2) air contaminated with volatile organic compounds (TCE). The contaminated air stream passes through a granular activated carbon (GAC) filter, and will be monitored to ensure applicable air quality standards are met. Treated ground water is reinjected into the aquifer.

Periodically, carbon is steam regenerated. This process produces a mixture of water and TCE which flows into a decanter. TCE is removed from the bottom to a holding tank for recycling or disposal. After passing through the decanter, the water is returned to the air stripper to be retreated.

#### Community Comment No. 5

"Is the data you've gathered so far sufficient to effectively design and remediate the groundwater contamination?"

#### Response

No, the base began sampling and analyzing a network of both private and monitoring wells when TCE was first discovered. As the contamination spread, we increased the scope and complexity of our sampling program. Although the extent of contamination is generally known, we believe the data necessary to clearly establish the TCE plume boundaries is

lacking. However, Castle has committed to install monitoring wells both on- and off-site during the remedial design phase of OU-2. A scope of work for the installation of these wells has been developed and approved by EPA and Cal-EPA. Additional monitoring wells have enabled us to more clearly establish the plume boundaries. In addition, the existing extraction system has been assessed for effectiveness. It appears that the removal action has been successful at removing the most highly contaminated portion of the OU-2 plume.

Community Comment No. 6

"The identification of the plume you show on the slide is two dimensional. How deep is it and is TCE heavier than water?"

Response

In this area, we have identified three levels of groundwater that are contaminated with TCE. They are the upper and lower shallow aquifer which extends between 50 and 100 feet below the surface and the subshallow aquifer which begins about 130 feet and extends to approximately 250 feet below surface. Yes, pure TCE is heavier than water.

Community Comment No. 7

"Will your preferred alternative be completed in a timely manner and will it return the groundwater to California safe drinking water standards? You've said very little about soil contamination. How do you propose to cleanup the contaminated soil above this aquifer?"

### Response

Cleaning up contaminated groundwater may take many years. We believe it will probably take until the year 2017 to complete the CERCLA process. However, Castle is committed to cleaning up contamination created by our flying mission over the last 50 plus years. We are looking at several different methods and/or technologies to clean up contaminated soils. Soil cleanup will be investigated pursuant to the Source Control Operable Unit (SCOU) which is currently underway.

### Community Comment No. 8

"I do not believe that your plan for cleanup is accurate as it is my understanding that three test wells have been placed on my clients' property. From your records these wells are 701, 702 and 702A. Well, 702A contains TCE and benzene as both have been identified in the groundwater supply with TCE at a level in excess of the safe drinking water standard. Because of the test wells identifying TCE located in the groundwater beneath my clients' property, I am of the opinion that the plume identified on your map is inaccurate and should be amended to reflect its actual extension beyond the base as identified in your Interim Design Report OU-1 for Castle AFB, dated Feb. 7, 1992, as well as earlier environmental surveys. We would appreciate a response to the following questions: (1) response regarding modifying the plans; (2) proposed scope of cleanup and extension of the existing plume; (3) estimated time of completion of the remedial action and work plan; and (4) the compensation to be provided to my clients for damages, now identified from these test wells, to their real estate."

### Response

The Interim Design Report for OU-1 covers the main base sector (MBS) contaminant plume, and as such it is not intended to address groundwater in the vicinity of your client's property. OU-2 covers the area you are concerned with. In response to your questions: (1) Castle does not plan to modify its plans for OU-1 (the MBS plume). (2) The proposed scope has not changed and Castle continues to be committed to clean up contaminated ground water it has caused to drinking water standards. (3) Castle's consultants believe it will take approximately 20 years to complete the cleanup at OU-2, the work plan for the design of OU-2 should be complete sometime in 1993. (4) Castle is not aware of any real property damages to and/or on your clients real property.

### Community Comment No. 9

Cal-EPA, DTSC, concurs with the use of the air stripping technology for treatment of ground water containing volatile organic compounds. However, in order to effectively design and remediate ground water contamination, all necessary data must be collected. DTSC has expressed existing deficiencies of data for OU-2 in previous correspondences to Castle. It remains DTSC's position that this data must be obtained before finalizing the OU-2 design.

### Response

Castle agrees with this position. Reference Response No. 5.

#### Community Comment No. 10

It is DTSC's understanding that Castle will implement as part of the design, activities to define both the vertical and lateral extent of ground water contamination within the boundaries of OU-2 and determine aquifer characteristics, including gradients, transmissivity, water quality parameters and background water quality conditions.

#### Response

Castle recognized the need to do further characterization studies of the ground water contamination to better define the plume. Subsequently, a workplan was developed, reviewed and approved by the parties to the Castle AFB Federal Facility Agreement. Reference Response No. 5.

#### Community Comment No. 11

From a meeting between the EPA, Region IX, and DTSC, it was agreed that revisions to the text of OU-2 Proposed Plan Fact Sheet would be made pursuant to 40 CFR 300.515(e) to address the State of California's concerns. However, the OU-2 Proposed Plan Fact Sheet was released prior to the incorporation of the negotiated revisions. DTSC is therefore submitting the items for inclusion into the Administrative Record and for incorporation into the OU-2 Record of Decision. The State of California specifically requested that the ROD shall address and include the following: (1) A statement that the onsite and offsite plumes are not completely defined and that monitoring wells will be drilled both onsite and offsite during the design phase to clearly establish the plume boundaries. Additionally, offsite extraction wells

and related piping may be needed within the plume. A general schematic of the extraction well, treatment and injection well system will either be added to the proposed plan or used as a graphic at the public meeting. (2) A detailed technical scope of work will be developed for the additional plume characterization for the OU-2 plume in all aquifers. The scope of work will be the basis for the time schedule. Phased implementation of the design will be considered. (3) An overall project schedule will be developed to balance investigation and remediation priorities between reuse and "worst first" work. Streamlining the technical and administrative processes will be a major goal of this effort. (4) Where sufficient technical information is available, specific State ARARs will be included in the OU-2 ROD. If specific design phase investigation information is identified as critical for ARARs development, then those ARARs will be provided after that information becomes available. This information and subsequent ARARs should be provided prior to 10 percent design completion.

#### Response

Because of the lack of funding at Castle, EPA produced and mailed the final proposed plan fact sheet for Castle. The fact sheet was released to the public on April 27, 1992. The specific language requested by DTSC and California Regional Water Quality Control Board, Central Valley Region (RWQCB) is addressed in this ROD. ARARs are also established in the ROD.



#### Community Comment No. 12

The RWQCB believes the preferred remedy has been selected with data that is insufficient and which lacks water quality information needed for the ROD to set numerical ARARs for many constituents. Without adequate plume definition, water quality characterization of the plume and the potential reinjection areas, and aquifer characteristics it is technically inappropriate to select a ground water treatment scheme that is very dependent on these parameters. Also, without the necessary water quality data it is impossible to protect the ground water resource in the reinjection areas. We are not opposed to the use of air stripping technology for treatment of ground water. However, all necessary data needs to be collected before the design of the remedy.

#### Response

Information on plume definition, potential reinjection areas and aquifer characteristics will be collected during the design phase in order to avoid delays in implementation of the remedial actions. Castle agrees with this comment. Reference Responses No. 5, 10 and 11.

#### Community Comment No. 13

The TCE plume has not been completely defined. Many questions have been raised by EPA, DTSC and RWQCB on the vertical and horizontal extent of this plume. This work should be done prior to any design on the treatment system. This will allow the initial system design to incorporate the whole plume. This work needs to be accomplished prior to 10 percent design completion.

#### Response

Castle has committed to further characterization in order to finalize the design of the remedy for OU-2. In order to implement the remedial actions as soon as is technically possible, data will continue to be collected during the design phase. Reference Response No. 5.

#### Community Comment No. 14

Insufficient water quality data has been done to set chemical specific ARARs for reinjection. In order to determine how Castle AFB will meet the State Board Resolution 68-16 (the Anti-degradation Policy) ARAR when it reinjects effluent, additional water quality characterization is necessary. This information will be used to prevent other potential contaminants (metals, DBCP, nitrates, etc.) from being reinjected into other areas with higher quality water, reducing or eliminating its beneficial use. This data needs to be collected prior to the 10 percent design completion thereby enabling the system to be designed effectively to clean up the solvent plume as well as protect the water quality at the reinjection areas.

#### Response

Compliance with ARARs is documented in this ROD. Castle agrees that additional remedial investigative activities need to occur prior to finalization of the design. The State of California will have the opportunity to review the OU-2 design and remedial action workplan to ensure that their concerns are addressed. Reference Responses No. 5, 10, and 11.

Community Comment No. 15

Aquifer characteristics (gradient, conductivity, etc.) have not been determined for much of the OU-2 area, especially in the off base sector of the plume. This needs to be completed before any treatment design is done, so that the system can be designed effectively. This should be completed prior to 10 percent design completion. This will allow the treatment system to be designed effectively to clean up the solvent plume as well as protect the water quality at the reinjection areas.

Response

Reference Response No. 5, 10, 11, 13 and 14.

Community Comment No. 16

RWQCB request the following language be included in the ROD to clarify how Castle AFB will proceed in collecting the data and developing the design for the OU-2 remedial action:

(1) A detailed technical scope of work for the OU-2 area will be developed to include complete plume definition, characterize water quality of the plume and of the receiving aquifer, and determine aquifer characteristics. The scope of work will be the basis for the time schedule. Phased implementation of the design will be considered. (2) An overall project schedule will be developed to balance investigation and remediation priorities between reuse and "worst first" work. Streamlining the process will be explored by technical staff. and (3) Specific ARARs will be included in the OU-2 ROD. In order to determine how Castle will meet the State Board Resolution 68-16 (the Anti-degradation Policy) ARAR when

it reinjects effluent, additional water quality characterization is necessary. This information will be provided prior to 10 percent design completion.

Response

Section VIII, Subsection H, and Section 9 address RWQCB's points 1 and 2 above. Castle has committed to undertake the work necessary to complete the design of the remedial system. Reference Responses No. 5 and 14.